

FIFTEENTH ANNUAL REPORT
OF THE
SANITARY ENGINEER

TO
GOVERNMENT, UNITED PROVINCES.

FOR THE YEAR ENDING 31st MARCH 1910.



A L L A H A B A D :
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1910.

Fifteenth Annual Report of the Sanitary Engineer to Government, United Provinces, for the year ending 31st March 1910.

THE post of Sanitary Engineer to Government, United Provinces, was held by Mr. W. G. Wood, Superintending Engineer, 2nd class, throughout the year, except for about 10 weeks (i.e., from the 12th of August to 31st October 1909) when he officiated for the Hon'ble Mr. C. E. V. Goument, as Secretary to Government and Chief Engineer, Public Works Department, Buildings and Roads Branch, United Provinces, and was replaced by Mr. A. W. E. Standley, Executive Engineer, 1st Grade.

Besides the eight water works stations the following places were visited by the Sanitary Engineer, during the year for the purpose of inspecting works or advising municipalities on sanitary schemes: Aligarh, Bareilly, Budaun, Dehra Dun, Dhampur, Etawah, Farukhabad, Firozabad, Gorakhpur, Deoria and Captain-ganj, Hardwar, Hardoi, Jaunpur, Jhansi, Mirzapur, Moradabad, Shikohabad, Saharanpur, Shahjahanpur and Unao.

The construction staff on Drainage Works during the year was :—

Mr. A. E. J. Hubbard, in charge of the Moradabad Drainage Works.

Mr. A. Woods, who, in addition to his work as District Engineer of Budaun, carried out the drainage project there.

Mr. R. Miles, in charge of the Firozabad Drainage Works under the Executive Engineer of Agra.

The project staff was :—

Mr. H. E. Parker, Assistant Sanitary Engineer to Government, United Provinces.

Mr. H. J. Amore, Assistant Engineer.

Mr. A. K. Nandi, Assistant to Sanitary Engineer to Government, United Provinces.

All the water works stations worked well during the year. There were no serious accidents and consequently the supply of water was regular throughout the year. The new Rising Main at Benares was connected with the old one at Settling Tank No. 1. At Lucknow a new double drum Babcock and Wilcock Boiler with superheater was installed and the old economiser removed and re-erected here, and the old boiler thus released was moved to the filtered station. A new flue was also built. The work on the installation of the New High Duty Worthington Engine at the unfiltered station Bhadaini in the Benares Municipality is being pushed on and is expected to be finished very shortly. The Engine house and Pump pit are now complete. The Pump pit work was delayed owing to a bad slip taking place into the excavation. This pit was 50' deep, in made ground, which necessitated very heavy shoring work.

Pumps and engines.

At Mussooree the motor driven pumps in connection with the Hydro-Electric scheme started regular pumping from Murray Springs on 11th May 1909. There were a good many interruptions in the working of these pumps but only such as are to be expected in a new plant working under a head of 1,700 feet. From the beginning of June to the end of October the only serious stoppage in the motor pumps was due to the wrecking of the Power Pipe line at the double crossing of the Bhatta stream in the month of August caused by an abnormal flood aggravated by a landslip along the valley traversed by the Power Pipe line. This brought the whole Hydro-Electric scheme to a stand-still as regards the water supply and electric lighting for a couple of weeks while the pipe line was being temporarily repaired. A committee of Engineers was convened to decide on the final alignment of the Power Pipe line to render the line safe from being breached in future monsoons. It was finally, after considerable discussion, decided to take the pipes under the bed of the river, adhering with slight alterations to the present alignment. The committee's recommendations are now being carried out vigorously and it is hoped that the line will be perfectly safe before the next monsoon. The motor pumps are well up to the stipulated delivery of 180 gallons per minute so that there is not likely to be any shortage in the water supply at Mussooree for years to come.

Extension of pipe lines was made at all stations. Several leaks were found in Benares and one burst occurred in the 3" main at Agra owing to the bridge having collapsed on account of the heavy rains; 19 bursts are reported from Benares but they were all repaired instantly.

Filters

One new filter was constructed at Agra and 2 are under construction at Lucknow. These are expected to help considerably to keep up the supply when the demand is heaviest. The filters at Lucknow were severely tested during the rains, as the river water contained a very large proportion of clay silt which passed through the settling tanks on to the filters and clogged them. The difficulty was effectually remedied by the use of alumino ferric in the settling tanks. Most of the filters of all the water works were cleaned and renewed with sand.

Settling Tanks

Three settling tanks in the Cawnpore Water Works have been emptied and a large quantity of silt near the inlets due to the action of alumino ferric was taken out. The tanks in Meerut and other places were in good condition all the year. The use of the alumino ferric was for the first time started in Cawnpore in June 1909 and its action was found most beneficial; as stated above, it was also employed in Lucknow. A short note on its use is being prepared and will shortly be issued to all the Water Works Superintendents for guidance.

With the exception of Agra and Mussooree the consumption of water at all other places was far less during the year under report than in the previous one and this seems to be due to the more extensive use of meters and better supervision over public and private consumption. The number of house connections at Agra is rapidly increasing and as the consumption of water has now overtaken the Engine power at the water works it is proposed to improve the distribution system and the water works Power Installation at a cost of Rs. 3,30,000. An estimate for supply of canal water to the water works of this place is also under preparation, the river supply being very low during the hot weather months. The demand for water in Cawnpore is very great and the question about extending the water works here is still under consideration. The scheme for the supply of unfiltered water in Allahabad is engaging the attention of the Municipal Board and the Government, but nothing has been finally settled yet. Proposals for improvements in the water supply at Naini Tal were made and the Government has sanctioned erection of a Jewel Filtering plant for the water works Installation at a cost of Rs. 32,000. This work is now in hand. The water works at Dehra Dun are practically completed and a project for supply of water to the Mirzapur municipality is under preparation and will shortly be submitted to Government for final sanction.

The result of analysis of water is given in Appendix IV. The quality of water supplied during the year was uniformly good. Endeavours are made to keep the rate of filtration down to 30 gallons per square foot in 24 hours, but this is often impracticable during the hot weather months when the demand for water is excessive. As, however, the number of filters and settling tanks has since been increased at some places and the use of alumino ferric started it will be possible to endeavour to adhere to this rate in future.

Drainage Works.

In the absence of a regular procedure much time and labour used to be wasted in preparing the drainage projects. With a view therefore to facilitate preparation of such schemes in a more methodical way directions and type designs were prepared and issued and the numerous drainage schemes now on hand are all being prepared on these lines.

The construction of the Moradabad drainage project is progressing satisfactorily and work of nearly half the value of the total estimate has been finished. The drainage scheme of the Fyzabad municipality was revised during the year under report. The drainage project of the Jaunpur municipality was also revised and the construction was commenced by Mr. H. Lane Brown in November 1909. Nearly half the work was practically finished. The paving has improved the insanitary quarters and is much appreciated. The construction work at Ujhani is completely finished and that in Budan was commenced in April 1909 and is nearing completion. Both these works were carried out by the Public Works Department and that in Firozabad was also taken up in November last as a contribution work under Mr. R. Miles, a temporary Assistant Engineer. The construction of drainage works in the Sardhana municipality was also started and those in Kanauj and

Farrukhabad are being carried out under the supervision of their own Overseer. The drainage project of the Government Press at Allahabad was also prepared and sanctioned and the construction work is proceeding under the Public Works Department.

The projects which were sanctioned and work commenced were as follows :—

Name of work.	Amount of estimate. Amount financed	
	R.	R.
Buland	3,10,576	71,191
Jaunpur	4,66,007	1,50,000
Farrukhabad cum Fitchgarh ...	84,186	Not known.
Agra Supplementary Drain ...	19,119	Completed.
" Sullage Farm	19,338	19,338
Ujhani	1,733	Completed.
Saidhana	2,165	2,165
Lucknow (intercepting Sewer) } (Ghasiarimandi and Husainganj scheme.) }	1,25,878	Completed.
Meerut	5,25,939	The whole.
Prizabad	1,12,155	About 50,000.
Government Press, Allahabad ..	21,941	The whole.

Projects which were finally sanctioned but work not started—

	R.
Khurja	1,37,840
Hapur	2,63,893
Fyzabad	1,533
Gorakhpur (storm water)	24,500
Almora	27,916
Hathras (Supplementary drainage) ...	81,733
Kanauj	23,885

The following projects were prepared by Mr. H. Lane Brown under the Sanitary Engineer's supervision and submitted for sanction.

	R.
Shahjahanpur	3,69,808
Shahjahanpur	6,57,416

The following schemes were prepared by the Sanitary Engineer and submitted for sanction but have not yet been laid before the Sanitary Board.

	R.
Mainpuri	2,66,693
Etawah	3,69,095
Amroha	2,67,543
Gorakhpur	5,71,151

The following schemes are still in hand : Aligarh, Atrauli, Meerut, Dhampur, Jhansi, Fatehpur, Hardwar, Shahganj and Etah.

The Allahabad drainage scheme, a big project formerly prepared by Mr. Lane Brown, is now being revised by him under the Sanitary Engineer's directions. Eight more municipalities have also applied for drainage schemes.

Those for Ghazipur, Muttra, Brindaban and Azamgarh are to be revised.

The construction of the supplementary drain in Agra was put in hand on 1st November 1909 and completed at a cost of Rs. 19,149; the sullage of a portion of the city is now intercepted and drained by this drain and discharged at the outfall of the main intercepting sewer and no sullage is allowed into the river.

The purification plant at Chowka Ghat in Benares municipality continues to be working satisfactorily. The projects for the Husainganj and Ghasiarimandi schemes at Lucknow were revised completely and the work has now been started and the main drain constructed. The sullage of the whole city will be intercepted and discharged on land, where it is intended to be utilized in land irrigation. The sullage farm at Agra and the experimental plant at Lucknow for precipitating the sullage were visited by Dr. Gilbert Fowler, the eminent Sewage Chemist, in March 1909, and the views expressed by him in his report on the same are interesting and useful. The former continues to be working well and there was an increase of about Rs. 1,200 in its income during the year under report. The Lucknow Experimental Plant will now be given up.

The recommendations of the Commission appointed to enquire into the working of the sullage farm at Agra have been or were in process of being carried out

NAINI TAL,	}	W. G. WOOD, SURDG. ENGR.,
The 16th May 1910.		<i>Sanitary Engineer to Government, United Provinces.</i>

APPENDICES.

APPENDIX

UNITED PROVINCES

Statement of operations

Particulars	Agra	Allahabad	Benares
<i>Population.</i>			
By census of 1901 in Municipality . . .	165,981	159,545	208,121
Ditto Cantonments . . .	22,041	12,487	4,958
Number of inhabitants drawing their supply from mains.	188,022	172,032	208,121
<i>Consumption of water.</i>			
During the year, including Cantonment, gallons.	910,216,100	761,512,831	1,515,184,024
Daily average, including cantonments, gallons...	2,576,017	2,086,336	4,233,380
Maximum quantity delivered in one day, gallons,	2,776,158	2,906,569	7,007,300
Water used for irrigation and manufacturing purposes, gallons.	85,100,000	44,538,667	13,797,000
Water used for domestic purposes, gallons	854,816,100	716,974,164	1,531,387,024
Water consumed per capita, gallons . . .	12.4	12.03	19.69
Daily average for cantonments alone, gallons . . .	218,044	161,302	1,322
Number of house connections . . .	1,511	2,679	7,314
Number of metered connections . . .	75	319	4
<i>Annual receipts and charges.</i>			
Maintenance charges Rs.	80,966	59,148	85,689
Cost per 1,000 gallons consumed . . .	1.39 annas	1.24 annas	0.88 annas
Cost per 1,000 gallons per 100 feet lift . . .	.77 annas	.73 annas	0.58 annas
Cost of water per 1,000 gallons including interest and sinking fund charges.	3.45 annas	3.47 annas	1.26 annas
<i>Income from water works.</i>			
Water rate recovered during the year . . . Rs.	84,790	89,012	97,276
Sale of water and other receipts . . . Rs.	31,652	32,984	8,544
Total Income, Rs.	116,442	121,996	105,820
<i>Lift of pump.</i>			
From river to settling tanks	45'	96.82'	78.82'
From filtered water pumps to town distribution.	147'	73.49'	72.04'
Total lift	192'	170.31'	150.86'

* Summer residential

† Cantonments not

Cold weather population

" "

No. 1.

WATER WORKS

during the year 1909-10.

Cawnpore	Lucknow	Meerut	Mussoorie	Naini Tal
172,674	240,565	75,740	*14,689	*11,220
24,196	23,407	39,389	2,711	914
172,674	263,975	113,129	11,680	15,164
1,299,551,069	735,802,576	300,232,100	†19,137,133	32,769,536
3,560,414	2,015,898	822,553	†71,071	89,779
4,375,504	3,114,477	1,114,218	111,458	198,360
324,952,912	30,512,156	4,175,610	Nil.	124,010
974,598,227	705,260,720	295,753,400	*9,737,133	32,645,526
20.62	7.6	6.96	3.63	7.5
...	215,180	318,913	Nil.	2,838
1,574	362	375	21	152
394	84	27	21	151
112,758	61,330	23,119	21,357	31,982
1.50	1.33 annas	1.23 annas	Re. 1.07	Re. 1.06
...	.719 annas	.87 annas	Re. .063	Re. .11
2.25	2.12 annas	3.53 annas	Rs. 2.95	Re. 1.77
Nil.	31,514	Nil.	Nil.	26,988
85,112	59,382	37,590	980	7,370
85,112	90,726	37,590	980	34,358
89.09'	107.7'	15.16'	Nil.	Tonnochy, 1,160'.
57.72'	71.9'	125.25'	1,700'	Ayarpatta, 1,090'. *Pilgrim, 240'
146.81'	179.6'	140.41'	1,700'	2,490'

population.

included

of Mussorie

... 4,741.

Naini Tal ...

... 6,908.

W. G. WOOD, SUPR. ENGR.,
Sanitary Engineer to Government United Provinces.

APPENDIX No. II.

Annual maintenance accounts of water works in the United Provinces during the year 1909-10.

Nature of charge	Agra	Allahabad	Benares	Cawnpore	Lucknow	Meerut	Mussoorie	Grand Total
1. <i>Establishment—</i>	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
(a) Permanent establishment	21,145	23,360	25,601	25,279	19,771	10,590	2,950	7,265
(b) Office contingencies	1,435	512	822	324	509	4,598	82	86
(c) Rents ...	...	1,150	160	...	430	360	...	100
2. <i>Pumping—</i>								
(a) Coal ...	30,076	19,152	31,738	33,934	19,789	14	6,363	18,593
(b) Oil and waste ...	2,822	854	2,701	2,496	1,124	570	105	416
(c) Other stores ...	2,168	1,327	3,227	4,539	2,830	2,504	621	958
3. <i>Intake—</i>								
(a) Training river ...	...	...	...	7,736	...	...	...	...
(b) Clearing channels and wells.	4,341	...	145	...	311	50	...	...
4. <i>Settling tanks and filters—</i>								
(a) Clearing settling tanks.	198	465	858	1,714	481	50	...	...
(b) Clearing and renewing filterbeds.	1,826	797	3,681	5,539	3,273	584	...	...
(c) Purchase of sand ...	6,836	338	2,982	10,263	5,021	...	...	...
5. <i>Distribution—</i>								
(a) Pipes and fittings ...	994	1,892	3,518	5,329	1,339	1,012	615	3,194
(b) Meters ...	459	2,843	...	8,253	792	...	...	93
6. <i>Repairs—</i>								
(a) To tanks ...	241	65	94	...	27	344	...	200
(b) To buildings and grounds.	1,503	786	751	612	1,170	853	...	1,221
(c) To machinery ...	1,771	3,440	7,220	5,477	3,781	...	...	1,684
7. <i>Water analysis</i> ...	2,150	2,137	2,188	1,083	593	1,590	140	1,172
Total ...	80,965	59,148	85,689	1,12,578	61,330	23,119	10,876	34,982

W. G. WOOD, SUPDG. ENGR.,
Sanitary Engineer to Government, United Provinces.

APPENDIX III.

Statement showing the initial capital cost and cost of subsequent extensions and improvements incurred on water works in the United Provinces up to 31st March 1910.

Water Works Stations.				Initial capital cost.	Cost of subsequent extensions.	Total.
				Rs.	Rs.	Rs.
Agra	...	...	...	11,70,761	6,24,921	17,95,682
Allahabad	...	...	...	16,24,061	1,51,474	17,75,535
Benares	...	...	...	25,61,881	4,22,369	29,84,250
Cawnpore	...	...	...	14,44,570	2,49,222	16,93,792
Lucknow	...	...	...	15,15,736	2,10,425	17,26,161
Meerut	...	...	...	7,51,710	27,356	7,79,066
Mussooree	...	...	...	1,44,014	10,876	1,54,890
Naini Tal	...	...	...	2,47,000	2,96,158	5,43,158

APPENDIX No. IV.

Statement showing the rate of filtration and results of water in the water works of the United Provinces during the year 1909-10.

Municipalities.	Rate of filtration.			Chemical tests.			Bacteriological tests.	
	Maximum.	Minimum.	Average.	Good.	Bad.	Total.	Number of tubes sent to Chemical Examiner.	Number which contained over 100 colonies.
Agra	30	20	26.17	12	1	13	90	nil
Allahabad	32	14	21.41	71	...	71	254	11
Benares	52	24	33.54	53	...	53	423	119
Cawnpore	50	26	31.14	52	1	53	198	11
Lucknow	45	15	27.6	59	2	61	294	11
Meerut	23	7	14.16	64	1	65	196	6
Naini Tal	...	...	...	12	...	12	...	...
Mussooree	...	...	...	...	...	...	...	...

W. G. WOOD, Super. Engr.,
Sanitary Engineer to Government, United Provinces.

Details of Pumps, Filters, Tanks, Reservoirs, Rising

Particular	Agra.	Allahabad.	Banaras
1. Consumption of water per capita in gallons.	12.4	12.08	19.69
2. Number of inhabitants drawing their supply of water from the mains.	188,022	172,032	208,121
3. Water used for irrigating and manufacturing purposes.	85,400,000	44,538,667	13,797,000
4. Power of pumps per hour in gallons of river	2 Horizontal pumps each— Designed for 84,000 Maximum ... 96,000 Average ... 78,000 1 Worthington Low Duty pump Designed for 120,000 Maximum ... 132,000 Average ... 102,000	Designed for 126,000 Maximum ... 154,961 Average 114,862	Designed for 252,000 Maximum ... 189,110 Average ... 172,383
5. Horse power each engine is designed for.	2 Horizontal pumps of 28 horse power each. 1 Worthington Low Duty engine of 31 horse power.	2 Engines of 102 horse power each.	4 Beam Engines of 43 horse power each.
6. Power of pumps per hour in gallons at filter.	2 Beam Engines each Designed for 192,000 Maximum ... 200,000 Average ... 180,000 1 High Duty Worthington. Designed for 150,000 Maximum ... 156,000 Average ... 144,000	Designed for 223,300 Maximum ... 265,000 Average ... 188,453	Designed for 450,000 Maximum ... 455,809 Average ... 375,150
7. Horse power each engine is designed for.	1 High Duty Worthington of 130 horse power. 2 Beam Engines of 100 Horse power each	2 Engines of 135 horse power each.	2 Horizontal engines 38 horse power each.
8. Number of rising mains ..	2	1	2
9. Length of rising main: ..	2.5 and 1.75 miles respectively.	1.9 miles	82 and 94 miles respectively.
10. Size of rising main: ..	24" and 18"	20"	24"
11. Number of settling tanks ..	5	3	3
12. Size of settling tanks ...	Each 200' × 151' Capacity of each 2,200,000 gallons.	Each 280' × 180' Capacity of Nos. 1 and 3 = 2,733,065 gallons, and that of No. 2 = 2,819,243 gallons.	(288' + 20') (238' + 20') × 15'. Capacity of Nos. 1 and 3 = 4,672,922 gallons, and that of No. 2 = 4,724,227 gallons.
13. Number of filters ..	7	5	8
14. Size of filters ...	Each 200' × 10'	200' × 100'	200' × 100' × 6' — 4 1/2"
15. Number of C. W. Reservoirs ..	3	2	2
16. Size of C. W. Reservoirs ...	103' × 105' × 10'	Each 160' × 103.3' × 12' Capacity ... 1,168,700	(178' — 4") (148' — 4") (16' — 1"). Capacity 1,879,631 gallons.
17. Number of service reservoirs or stand pipes.	43 Four-tap standposts each 1/2" size; 62 two-tap standposts of 3/4" size; 150 one-tap standposts.	49 Four-tap standposts, 54 two-tap standposts and 123 one-tap standposts each of 1/2" size.	232 One-tap standposts, 102 two-tap standposts, 73, four-tap standposts.

Mains, &c., in the Water Works of the United Provinces for 1909-10.

Cannanore.	Lucknow	Meerut	Mussaoree.	Naini Tal
20.62	7.6	6.96	3.68	7.5
172,674	263,975	118,129	14,689	15,164
324,952,842	30,542,156	4,478,640	Nil	124,010
Two Pumps each— Designed for 187,500 gallons. Maximum 187,500 gallons. Average 165,000 gal- lons.	Designed for 187,500 Maximum 188,237 Average 178,517	Designed for 72,000 Maximum 61,985 Average ... 37,037	Designed for 2,500 Average . . 2,400 Maximum... Not known.	Lake station 14,355 Baranadi } Springs } 13,326
2 Engines of 86 horse power each.	2 Engines of 130 horse power each.	1 Engine of 26 horse power.	Each motor pump designed for 150 horse power.	31 horse power.
Two Pumps each— Designed for 187,500 Maximum 187,500 Average 174,375	Designed for 187,500 Maximum Not known. Average 117,028	Designed for 66,000 Maximum . . 50,611 Average ... 30,327	Nil	Nil.
2 Engines of 80 horse power each.	2 Engines of 110 horse power each.	...	Nil	...
2 1.32 miles	1 3.5 miles	1 9 miles	1 1.18 miles.	4 { Ayarpatta .93 miles. Tonnochy .65 " Pilgrim .34 " Lake .19 mile. 4", 3½", 3", 4" Nil. Nil.
Each 20" dia. 3 Each 355' x 255' capacity 3 million gallons.	20" 3 250' x 200'	15" 3 100' x 60' x 11'	3½" Nil Nil	
7 200' x 100' 2	5 200' x 100' 2	4 150' x 100' 1	Nil Nil 1	Nil. Nil.
Each 135' x 106'—8" x 12' deep. Capacity of each 953,300 gallons. 107—4 tap standposts 62—2 ditto 87—1 ditto 50'—6" high x 36' dia.	Each 105' x 107' 150, one-tap stand- posts; 238 two-tap standposts.	48' x 52½' 32, one-tap stand- posts of ½"; 84, two tap standposts of ¾".	80' x 24' x 6' 3 iron tanks each 8' x 4' x 4', 8 stand- pipes of 2 taps.	64 service tanks, 27 standposts.

*Summer population.

Particulars	Agri.	Allahabad.	Banarasi.
13. Size of service reservoir ...	66' dia. x 11'—4" deep	60' dia. x 11' deep.	60' dia. x 15' deep. Capacity 200,000 gal- lons.
19. Lift of pumps from river to settling tanks.	45 feet head	96·82'	78·82
20. Lift of pumps from filter water pump to town distribution.	147 "	73·49'	72·01
21. Cost of supplying water per 1,000 gallons.	1·39 annas	1·24 annas	0·88 annas
22. Cost of supplying water per 100' lift	·77 "	·73 annas	·58 annas

No. V.

Mains, &c., in the Water Works of the United Provinces for 1909-10—(concluded).

Cawnpore.	Lucknow.	Meerut.	Mussoorie	Naini Tal.
Holds 320,000 gallons	66' x 12'	2—Each 25' x 34'	..	28 Round service tanks 3' x 3', 28 round service tanks 2'—8" x 3', 8 square tanks 6' x 8' x 4'.
89·09'	107·7'	15·16'	Nil	From collecting reservoir to Tonnochy... 1,160'
57·72	71·9'	125·25'	...	Ayarpatta ... 1,090'
1·50 annas	1·33 annas	1·23 annas	Re. 1·07	Pilgrim ... 240'
...	·719 annas.	·87 annas	„ ·063	... ..
				Re. 1·06
				„ ·11

W. G. WOOD, Suptg. Engr.,
Sanitary Engineer to Government, United Provinces.

APPENDIX VI.

Detailed statement showing the expenditure incurred on works of sanitary nature, executed under the supervision of Sanitary Engineer, during 1909-10.

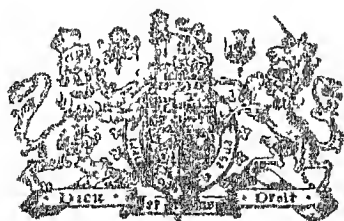
Name of Municipality.	Expenditure incurred on—			Total expenditure.
	Water works.	Drainage works.	Other works.	
Agra	56,264	30,013	...	86,277
Allahabad	2,113	...	2,113
Lucknow... ..	28,378	160,221	...	188,599
Mirzapur	2,637	2,637
Farrukhabad	19,994	...	19,994
Dehra Dun	13,046	...	...	13,046
Moradabad	151,642	...	151,642
Aligarh	2,815	3,928	6,743
Hathras	57,776	...	57,776
Budaun	58,998	...	58,998
Jaunpur	72,893	...	72,893
Ujhani	2,468	...	2,468
Sardhana...	819	...	819
Firozabad	13,335	...	13,335
Khurja	2,377	...	2,377
Hapur	1,451	219	1,670
Kananj	4,562	...	4,562
Mainpuri...	1,347	...	1,347
Etawah	1,202	...	1,202
Amroha	74	...	74
Atrauli	1,351	...	1,351
Dhampur...	774	...	774
Jhansi	979	...	979
Fatehpur...	534	...	534
Hardwar...	461	...	461
Shahganj...	15	...	15
Etah	50	...	50
Total	97,688	588,264	6,784	692,736

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FOURTEENTH ANNUAL REPORT
OF THE
SANITARY ENGINEER

TO
GOVERNMENT, UNITED PROVINCES,

FOR THE YEAR ENDING 31st MARCH 1909.



A L L A H A B A D :

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Fourteenth Annual Report of the Sanitary Engineer to Government, United Provinces, for the year ending 31st March 1906.

The post of Sanitary Engineer to Government, United Provinces was held temporarily by Mr. A. W. M. Standley up to 15th November 1905, when he reverted to the Irrigation department, making over charge to Mr. W. G. Wood, Superintending Engineer, 2nd Class.

2. Besides the 8 water works stations the following places were visited by the Sanitary Engineer during the year 1904-05 in connection with the drainage works: Fyzabad, Mussouri, Debra Dun, Saharanpur, Moradabad, Amroha, Gorakhpur, Muttra, Jhansi, Bareilly, Hapur, Aligarh, Hathras, Nagina, Etawah, Firozabad, Mehapur, Farrukhabad, Kanpur, Etah, Sandham, Fotehpur, Shahjahanpur, Tihar, Budaul, Ghazipur, Jampur, Shahganj, Kadiana and Muzaffarnagar.

3. All the water works stations have worked well and satisfactorily during the year and there have been no serious accidents. At Cawnpore the ends of both main pump rods of engine No. 2 at Bhanougarh broke off and the repairs took about five weeks. The pump foot valve of engine No. 2 at Benjhabat broke and was replaced. These minor accidents accentuate the necessity for increasing the pumping plant at Cawnpore. At present during the hot weather all four engines have to work about 15 hours daily to meet the demand, and any breakdown would mean the breakdown of the water supply. The scheme for a new installation is still under discussion.

4. A large amount of annual repair work and renewals was done at Cawnpore, Agra, Lucknow, Allahabad and Benares. The following additions and extensions have been or are being carried out.

At Benares a new Rising Main 24" diameter and formed of the new Mophan Ferguson Lock Bar Steel pipes has been put in from the Unfiltered station to Settling tank No. 1. A new filter was completed and a new boiler put in at the Filtered station, and 2 new Babcock and Wilcox boilers were under erection at the Unfiltered station for the supply of the new engine. The new engine for the Unfiltered station was ordered and some parts of it are at site. The estimate for a new pump pit and engine house was drawn up and sanctioned and work commenced just at the end of the year.

5. The above is practically all the large new Water Works *construction* carried out or commenced during the year with the exception of the Mussoorie Hydro-Electric Scheme mentioned further on, but the water works requirements are heavy, due to the constantly increasing demand for water, the consumption of which is steadily rising.

At Lucknow an estimate for new boilers, settling tank, balancing tank, and Venturi meters has been sent up for sanction.

At Cawnpore, as already mentioned, a scheme for improving the pumping plant was submitted, amounting to Rs. 6,00,000, but the matter is still under discussion. At Allahabad, a scheme for an unfiltered water supply amounting to Rs. 3,83,292 was submitted, but this has also not yet been finally settled. Extensions to the Agra works were discussed, but nothing has yet been settled. At Naini Tal the supply of water was insufficient last year owing to the springs drying up, and the supply had to be augmented from the percolation well. The matter of an increased supply for Naini Tal is being investigated. At Mussoorie the supply at present pumped is of course quite inadequate, and the new Hydro-electric scheme will take its place. This scheme was pushed on well during the year. The power house, power pipe line, pump house, rising main and reservoirs are all nearly complete and the transformer stations built. The wiring has advanced rapidly and is approaching completion. The work has been carried out under great natural engineering difficulties. The power pipe line is a magnificent piece of work, for which the municipality are indebted to the untiring skill and energy of Mr. Pitkeathly and Mr. Renny, Messrs. Bruce Peebles & Company's engineers.

6. The question of the waste of water has been considered by the different municipalities. Cawnpore spent Rs. 10,776 on the purchase of additional meters.

Lucknow have decided to purchase two venturi meters. Benares and Agra have at present no money to provide more meters, but a number of defective taps have been repaired. At Allahabad Rs. 3,595 were spent on meters, but no special metering has been attempted; there does not, however, appear to be much waste here.

7. The water supplied has been generally of good quality. The rate of filtration through the filters and the chemical and bacteriological analyses will be found in Appendix No. IV. The sand on all filter beds is now not scraped below 2' thickness, as some of the bad bacteriological tests were due apparently to the sand having been scraped too low. Endeavours have been made to keep the rate of filtration down to 30 gallons per square foot in the 24 hours, but in the hot months this is not possible, as the filtering area is not great enough to give the supply. The question of this rate is important as filters are costly things, and the lower the rate of filtration the greater the number of filters necessary.

Drainage Works.

8. During the year very little progress was made in construction of new works; as the revision of the completed projects for Saharanpur, Muttra, Jaunpur, Bulana, Ujhani, Moradabad, Ferozabad and Khurja prevented a start being made. The drainage of Hathras—Rs. 1,84,050, was completed. The Moradabad project—Rs. 4,81,457—was completed and sanctioned and work commenced in January 1909. Mr. A. E. J. Hubbard, a temporary Assistant Engineer, was placed in charge, and good progress was made with the Katgarh and Eastern main sewer outfalls, at a cost of Rs. 43,000. The whole scheme has been taken up by the Board and it is being vigorously pushed through. The revised project for Jaunpur—Rs. 4,66,607, was completed and sanctioned and work commenced at the end of the year on a portion of the project amounting to 1½ lakhs, which was all the municipality were able to finance.

At Farrukhabad work proceeded during the year on a sanctioned project; an estimate for the completion of the drains here is still under consideration. The projects that were submitted and sanctioned were—

	Rs.
Bulana	3,10,876
Ferozabad	1,12,000
Gorakhpur storm water drain	24,500
Lucknow (two intercepting sewers) ..	1,24,336
" (Ghasiari mandi and Husainganj drainage)	5,25,936
Nagina (supplementary works)	27,378
Total	11,25,026

The projects completed and submitted but not yet sanctioned were—

	Rs.
Khurja	1,37,840
Ferozabad	3,79,533
Hapur	1,02,612
Ujhani	4,793
Amroha	2,44,966
Total	8,69,684

The following schemes are still in hand :—

Saharanpur, Gorakhpur, Farrukhabad, Kanauj, Etawah, Mainpuri, Aligarh and Shahganj.

Four projects were prepared and submitted by Mr. Lane Brown as follows :—

	Rs.
Ghaziipur	4,35,688
Muttra	5,31,068
Brindaban	2,49,960
Allahabad	17,00,000
Total	29,16,716

but these will require revision, and, the staff being fully employed they have not at present been taken up.

Thirteen other municipalities have also applied for drainage schemes.

All the schemes are surface drainage scheme, for the disposal of sullage and storm water. No sewage is treated, that being disposed of as at present by trenching. Wherever the levels allow of it, the sullage will be disposed of on land by gravity, a sullage farm being started by the municipality. In some places, such as Aligarh and Amroha, the levels do not admit of the sullage gravitating to the sullage farm, and it will have to be pumped. It is hoped that eventually these sullage farms will be a source of revenue to the municipalities. At present it is somewhat difficult to get the people to use the water. One reason for this is that in non-watered towns (i.e. towns without a regular piped water supply) the sullage is very strong. To get over this difficulty it must be diluted. Ample provision for flushing the drains has been made in all the projects, but, if possible, the sullage should be further diluted by water from wells at the sullage farm itself.

The sullage farm at Agra was examined and reported upon by a special committee appointed by the Lieutenant-Governor, which submitted a very full and careful report on the 21st December 1908. The general conclusion was that the farm was not injurious to health and, if properly worked, should cause no nuisance. The income derived from it is Rs. 4,000 annually.

The experimental plant at Lucknow for precipitating the sullage and producing a clear effluent was visited by Dr. Gilbert Fowler, the eminent sewage chemist, at the end of the year as he had been asked by this Government to give his advice generally on the disposal of the sullage of towns. He also visited the farm at Agra. His report is now awaited. Sanitary conditions in several towns have been improved by the filling up of old tanks and excavations with street sweepings and rubbish, and in some cases where tanks have been filled up with earth at considerable expense, the municipality has covered its expense and gained a substantial sum by selling the site for the erection of shops. There is plenty of room for lucrative enterprise in this direction, and it deserves the serious attention of chairmen of municipal boards.

W. G. WOOD, *Supd. Engr.*,
Sanitary Engineer to Government, United Provinces.

APPENDICES.

APPENDIX

D. THE PROVINCE

of Orissa

			Lo. 100.
<i>Population.</i>			
By Census of 1901 in Municipality ...	16		
By Census of 1901 in Cantonments ...	2,500	1,100	
Number of inhabitants drawing their supply from mains.	185,023	112,053	297,076
<i>Consumption of water.</i>			
During the year, including Cantonments, gallons	93,221,700	2,470,581	1,775,115,865
Daily average, including Cantonments	2,558,700	2,470,581	4,816,468
Maximum daily average in any one month ...	2,805,000	3,113,000	5,499,936
Water used for irrigation and manufacturing purposes.	149,035,000	48,800,000	21,036,000
Water used for domestic purposes ...	759,205,500	779,867,384	1,554,109,865
Water consumed per capita ...	11.06	12.42	19.98
Daily average for Cantonments alone	220,249	179,486	1,358
Number of house connections ...	1,381	2,510	6,379
<i>Annual Charges.</i>			
Maintenance charges ...	Rs. 79,533	72,911	1,01,767
Cost per 1,000 gallons consumed ...	1.40 annas.	1.40 annas.	1.03 annas.
Cost per 1,000 gallons per 100 feet lift ...	.72 "	.81 "	.67 "
Cost of water per 1,000 gallons including interest and sinking fund charges.	3.10 "	2.47 "	1.46 "
<i>Income from Water Works.</i>			
Water rate recovered during the year	Rs. 76,514	86,412	96,170
Sale of water and other receipts ...	Rs. 33,362	40,457	8,595
Total income ...	109,876	126,869	104,765
<i>Lift of pump.</i>			
From river to settling tanks ...	45'	98.78'	78.73'
From filtered water pumps to town distribution.	147'	72.62'	73.52'
Total lift ...	192'	171.40'	152.25'

N.C.T.

T. P. S. S. S.

1903-1909

	In no r	Mer t	M t	Suma tal
172,574	240,563	78,710	11,659	11,229
24,126	2,007	59,509	3,711	944
177,674	238,975	11,509	11,659	15,164
1,011,910,117	142,843,582	306,204,000	1,524,809	53,203,179
2,014,630	2,037,941	811,592	1,1159	137,516
4,759,312	3,142,802	1,346,563	55,181	201,295
378,668,016	20,619,030	3,793,760	N.L.	211,350
1,011,920,201	717,229,552	302,517,019	8,937,809	53,018,789
1067	744	701	287	1231
...	233,090	356,221	N.L.	3,314
1,806	1,430	322	N.L.	130
1,06,253	65,811	26,162	Rs. 24,301	34,185
147 annas	14 annas.	136 annas.	" 233	10.26 annas.
...	76 "	1.11 "	" 037	1.62 "
292 "	303 "	36 "	" 2.64	17 rupees.
No rate	28,830	N.L.	N.L.	26,833
66,647	53,558	38,999	N.L.	5,415
Rs. 66,647	82,388	33,999	N.L.	32,248
81.01'	107.2'	15.16'	N.L.	{Tonnochy 1,160'
59.53'	76.0'	125.25'	620'	{Ayaspatta 1,090'
				{Pilgrim 240'
140.54'	183.2'	140.41'	620'	2,490'

* Summer residential population

† Cantonments not included.

Cold weather population of Mussoorie

" "

Naini Tal

...

...

...

4,741

6,903

W. G. WOOD, SUPD. ENGR.,

Sanitary Engineer to Government, United Provinces.

APPENDIX No. II.

Annual maintenance accounts of water works in the United Provinces during the year 1908-09.

Nature of charges.	Agra.	Allahabad.	Benares.	Cawnpore	Lucknow.	Meerut.	Mussoorie.	Naini Tal
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1. <i>Establishment—</i>								
(a) Permanent establishment.	23,800	22,591	26,252	24,484	19,615	10,127	{ 2,218 829* }	8,255
(b) Office contingencies	1,997	595	819	668	426	4,918	54	64
(c) Rents ...	...	1,320	197	...	430	360	...	234
2. <i>Pumping—</i>								
(a) Coal ...	28,736	25,581	48,513	36,950	23,694	554	18,938	19,254
(b) Oil and waste ...	2,889	982	3,353	2,704	1,287	507	240	857
(c) Other stores ...	2,569	1,652	3,376	3,713	2,755	3,127	...	592
3. <i>Intake—</i>								
(a) Training river ...	1,885	...	1	5,798	...	...	...	...
(b) Clearing channels and wells.	3,086	50	157	...	45	42	...	...
4. <i>Settling tanks and filters—</i>								
(a) Clearing settling tanks	397	630	181	1,198	524	49	...	...
(b) Clearing and renewing filter beds.	1,735	1,177	2,527	5,533	2,911	1,228	...	...
(c) Purchase of sand ...	...	3,286	1,087	6,580	1,293	...	...	...
5. <i>Distribution—</i>								
(a) Pipes and fittings...	2,001	2,773	6,105	2,186	2,535	565	...	2,592
(b) Meters...	2,080	3,595	...	10,776	2,429	...	...	...
6. <i>Repairs—</i>								
(a) To tanks ...	353	144	26	...	114	...	...	...
(b) To buildings and grounds.	1,885	1,276	877	1,183	775	1,137	...	1,064
(c) To machinery ...	4,991	6,797	7,714	4,003	6,044	3,398	1,857	959
7. <i>Water analysis</i> ...	1,179	462	582	532	464	120	165	314
Total ...	79,533	72,911	1,01,767	1,06,258	65,341	26,162	24,301	34,186

* Temporary establishment.

W. G. WOOD, SUPDG. ENGR.,
Sanitary Engineer to Government, United Provinces.

APPENDIX No. III.

Statement showing the initial capital cost and cost of subsequent extensions and improvements incurred on water works in the United Provinces up to 31st March 1909.

Water works stations.				Initial capital cost.	Cost of extensions, &c.	Total
				Rs.	Rs.	Rs.
Agra	...	...	...	11,70,761	5,68,657	17,39,418
Allahabad	...	...	...	16,21,061	1,51,240 ^{15,14,74}	17,75,301 ^{17,75,301}
Benares	..	...	...	25,61,881	2,32,950	27,94,831
Cawnpore	...	...	...	14,41,353	3,19,696	17,61,049
Lucknow	...	...	...	15,15,736	1,77,781	16,93,517
Meerut	...	...	...	7,51,710	25,299	7,77,009
Mussoorie	...	...	...	1,89,790	Nil.	1,89,790
Naini Tal	...	...	...	2,47,000	2,95,749	5,42,749
Dehra Dun	..	...	...	1,07,211	61,751	1,68,962

APPENDIX No. IV.

Statement showing the rate of filtration and the results of analysis of water in the water works of the United Provinces during the year 1908-09.

Municipalities		Rate of filtration.			Chemical tests.			Bacteriological tests.	
		Maximum.	Minimum	Average	Good	Bad.	Total.	Number of tubes sent to Chemical Examiner	Number which contained over 100 colonies.
Agra	...	30	20	20.4	15	1	16	226 ²¹¹	5
Allahabad	...	40.45	15.28	24.40	57	...	57	223	14
Benares	...	60	21	30.5	43	...	43	316	83
Cawnpore	...	31	27	29.50	57	3	60	131	5
Lucknow	...	48.1	12.8	23.27	8	...	8	221	8
Meerut	...	22.08	9.01	13.6	38	...	38	164	2
Naini Tal	...	...	...	...	49	3	52	...	...
Mussoorie	...	...	...	...	...	...	...	...	...

W. G. WOOD, Supd. Engr.,
Sanitary Engineer to Government, United Provinces.

Particulars.	Agra.	Allahabad.	Benares.
Consumption of water per capita in gallons.	11.06	12.42	19.93
Number of inhabitants drawing their supply of water from the mains.	188,022	172,032	213,079
Water used for irrigating and manufacturing purposes.	149,025,600	48,800,000	21,036,000
Power of pumps per hour in gallons at river.	2 Horizontal pumps each Designed for 84,000 Maximum ... 96,000 Average ... 78,000 1 Worthington low duty pump each. Designed for 120,000 Maximum ... 132,000 Average ... 102,000	Designed for 126,000 Maximum ... 154,961 Average ... 114,862	Designed for 252,000 Maximum ... 189,140 Average ... 172,383
Power of pumps per hour in gallons at filter.	2 Beam Engines each Designed for 192,000 Maximum ... 200,000 Average ... 180,000 1 High duty Worthington. Designed for 150,000 Maximum ... 156,000 Average ... 144,000	Designed for 223,300 Maximum ... 265,000 Average ... 188,453	Designed for 450,000 Maximum ... 455,809 Average ... 375,150
Number of rising mains ...	2	1	2
Size of rising main ...	28" and 18"	20"	24"
Number of settling tanks ...	5	3	3
Size of settling tanks ...	Each 266' x 151' Capacity of each 2,200,000 gallons.	Each 280' x 180' Capacity of Nos. 1 and 3, 2,733,065 gallons, and that of No. 2 2,819,213 gallons.	(288' + 20') (238' + 20') x 15'. Capacity of Nos. 1 and 3 4,672,922 gallons and that of No. 2. 4,724,227 gallons.
Number of filters ...	6	5	8
Size of filters ...	Each 200' x 10'	200' x 100'	200' x 100' x 6'4½"
Number of C. W. Reservoirs ...	3	2	2
Size of C. W. Reservoirs ...	103' x 105' x 10'	Each 160' x 103.3' x 12' Capacity ... 1,168,700	(178'—4") (148'—4") (16'—1"). Capacity 1,879,631 gallons.
Number of service reservoirs or standpipes.	43, 4 tap standposts each ¾" size; 62, 2 tap standposts of ¾" size.	49, 4 tap standposts 54, 2 tap standposts and 123 one tap standposts each of ¾" size.	232, 1 tap standposts 102, 2 tap standposts 73, four tap standposts.
Size of service reservoir ...	66' dia. x 11'—4" deep	60' dia. x 11' deep ...	60' dia. x 15' deep. Capacity 260,000 gallons.
Lift of pumps from river to settling tanks.	45'	98.73'	78.73'
Lift of pumps from filter water pump to town distribution.	147'	72.62'	73.52'
Cost of supplying water per 1,000 gallons	1.40 annas	1.40 annas	1.03 annas
Cost of supplying water per 100' lift	.72 "	.81 "	.67 "

No. V.

ains, etc., in the Water Works of the United Provinces for 1908-09.

Cawnpore	Lucknow.	Meerut.	Mussorie	Naini Tal.
16 57	7 44	7 01	2 57	12 31
172,674	263,975	118,129	14,609	15,164
278,569,916	26,619,030	3,793,760	Nil	244,350
2 Pumps each— Designed for 187,500 gallons. Maximum 187,500 gallons. Average 165,000 gal- lons.	Designed for 187,500 Maximum 188,237 Average 178,517	Designed for 720,000 72,000 Maximum 61,985 Average 37,037	Designed for ... 2,500 Average ... 2,400 Maximum ... Not known.	Lake station 14,355 Baranadi ... 133,206 (13,344) Springs ... 13,326
2 Pumps each— Designed for 187,500 Maximum 187,500 Average 174,315	Designed for 187,500 Maximum ... Not known. Average ... 117,028	Designed for 66,000 Maximum 5,061 Average 30,327	Nil.	Nil.
2 Each 20" dia. 3 Each 355' × 255' capacity 3 million gallons.	1 20" 3 250' × 200'	1 15" 3 100' × 60' × 11'	1 3 1/2" Nil. Nil.	4 4", 3 1/2", 3", 4" Nil. Nil.
7 200' × 100' 2	5 200' × 100' 2	4 150' × 100' 1	Nil. Nil. 1	Nil. Nil. 5
Each 135' × 106'—8" × 12' deep. Capacity of each 953,300 gallons. 107—4 tap standposts 62—2 ditto 87—1 ditto 50'—6" high × 36' dia. Holds 320,000 gallons	Each 105' × 107' 150, one tap stand- posts, 238, two tap standposts. 66' × 12'	48' × 52 1/2' 32, one tap stand- post of 3" 84, two tap standposts of 3/4". Each 25' × 34'	80' × 24' × 6' 8 iron tanks each 8' × 4' × 4', 8 stand- pipes of 2 taps. ...	64 service tanks, 27 standposts. 28 Round service tanks 3' × 3', 28 round service tanks 2' 8" × 3', 8 square tanks 6' × 8' × 4'. From collecting reservoir to Tenuochy... 1,160' Ayarpatta ... 1,090' Pilgrim ... 240'
81' 01'	107' 2'	15' 16'	Nil.	...
55' 53'	76' 0'	125' 25'	620'	...
1 47 annas	1 4 annas	1 36 annas	Rs. 2 38	10 20 annas
...	76 "	1 11 annas	" 0 37	1 62 "

W. G. WOOD, SURG. ENGR,
Sanitary Engineer to Government, United Provinces.

APPENDIX No. VI.

Statement showing expenditure on works of a sanitary nature constructed during the year 1908-9.

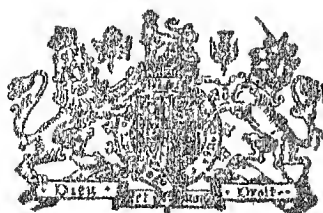
Names of municipalities.	Expenditure incurred on—			Total expenditure.
	Water works.	Drainage works.	Other works.	
	Rs.	Rs.	Rs.	Rs.
Agra	306	3,273	1,600	5,179
Allahabad ... ..	...	7,680	...	7,680
Mirzapur... ..	...	4,630	...	4,630
Lucknow... ..	...	15,213	...	15,213
Mussoorie	1,89,308	387	...	1,90,195
Farrukhabad cum Fatehgarh ...	...	4,431	...	4,431
Fyzabad ... ..	...	11,873	...	11,873
Dehra Dun	17,170	81	..	17,251
Deoband ... ..	...	11,447	...	11,447
Nagina ... ..	...	1,913	...	1,913
Moradabad ... ..	...	42,696	...	42,696
Hathras ... ..	...	1,27,726	...	1,27,726
Shahganj ... ..	...	243	...	243
Hapur ... ..	...	391	...	391
Benares ... ..	...	Nil.	...	...
Cawnpore ... ..	...	Nil.	...	...
Meerut ... ..	...	...	...	...
Naini Tal	29,360	29,360	...	29,360
Chandausi ... ..	...	...	...	...
Aligarh
Total	2,67,234 236,640	2,61,244 2,31,948	1,600	4,70,228

W. G. WOOD, SUPDG. ENGR.,
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FOR THE YEAR ENDING 31st MARCH 1909.



ALLAHABAD :

PRINTED BY F. LUKER, SUPDT., GOVT. PRESS, UNITED PROVINCES.

1908.

**Thirteenth Annual Report of the Sanitary Engineer to
Government, United Provinces, for the year ending 31st
March 1908.**

THE post of Sanitary Engineer to Government was held during the year by Mr. D. W. Aikman, Superintending Engineer, Public Works Department, up to the 28th February 1908, when he proceeded on leave and his place was taken up by Mr. A. W. E. Standley, Executive Engineer, 2nd grade.

2. Besides the eight water works stations the Sanitary Engineer visited during the year under report Azamgarh, Aligarh, Bareilly, Bulandshahr, Dehra Dun, Gorakhpur, Jhansi, Kasganj, Moradabad, Muttra and Nagina. In addition to these Mr. Aikman, under orders from Government, also visited Indore and prepared and forwarded to the State a note on the distribution of the proposed water supply for that city.

3. *Agra.*—The pumping machinery has worked well throughout the year. Spare parts of engines were ample and only one High Duty Engine oil pot was obtained and kept in reserve. The demand for water rose 11 per cent. but the High Duty Engine met it satisfactorily and no complaints were made.

The initial capital cost incurred on water works during the year under report amounts to Rs. 11,70,761. Six extra stand posts were erected for the public, and the Tajganj water supply completed at a total cost of Rs. 23,000.

The new Rider Main has worked well. The engines of both stations have been overhauled as usual and are in good order.

The new 6th Filter has been completed, and brought into use from the commencement of last year.

No complaint against the quality of the water was recorded during the year by the Chemical Analyst to Government, which is exceedingly satisfactory. There has been a saving of Rs. 7,938 in the quantity of coal used, and a new copula for smelting iron is being erected to enable the municipality to cast their collars, pipes, stand posts, &c., thus effecting economy in future.

All the three reservoirs were cleaned and washed during the winter as usual, and a new additional one is in very good condition.

One burst occurred on the big 28" Rising Main and 4 on rider main, but none occasioned any public inconvenience. The condition of the Board's pipe inside is satisfactory but that of galvanized iron pipes on the private connections is bad in many places and must be renewed soon.

Only 30 new house connections were given during the year, bringing the number up to 1,330.

Income from water rate, sale of water and other receipts is Rs. 1,13,344.

The cost of 1,000 gallons of filtered water works out to 1.39 annas against 1.45 annas of last year.

The intercepting sewer and Tunnel drain are working satisfactorily. The amount spent in paving two lanes and constructing drains at Bharatpur road and that near Jama Masjid is Rs. 60,282 and some Rs. 50,000 is wanted to pave those still on the Board's list. Owing to want of sufficient funds only 1,362 feet of drains could be made this year.

The sullage farm continues to be a success but, lately there has been a complaint from the medical authorities of the Fort, who wish all

sullage to be discharged into the river, to prevent which the Intercepting sewer was made with their concurrence and the sullage farm instituted. His Honour the Lieutenant-Governor, Sanitary Commissioner, Chief Engineer and other officials who visited the place have noticed the absence of any perceptible bad odour there. Its revenue has risen to Rs. 4,000, while the expenditure in leading the water is Rs. 1,200.

A new filth depôt of a novel design fitted with a water supply has been erected in the city close to Jama Masjid, and several other improvements made in the Department are mostly due to the good and careful supervision of Mr. Rogers.

4. *Allahabad*.—The pumping plant at both stations has worked satisfactorily and the boilers are kept in good order. The consumption of filtered water has increased by nearly 52 million gallons over last year, and with a view to check any misuse two water works sub-inspectors have been appointed. The number of house connections has reached 2,391 this year. The income from water rate and other receipts is Rs. 1,26,270 and the maintenance charges are Rs. 74,219 only. The cost of 1,000 gallons of filtered water is 1·4 annas.

The settling tanks and filters have been cleaned.

Unfiltered water supply.—The proposal for supply of unfiltered water for public and private gardens, &c., at Allahabad is still under consideration.

Twenty-six thousand and seven hundred square feet of lanes were paved with stones and 6,614 feet of drains were laid. One new latrine has been erected and the 15 erected last year have been completed with approach roads and sweepers quarters, etc., the total cost incurred on these being Rs. 3,540.

The Lukerganj drainage project has been sanctioned at a cost of Rs. 19,650 and the work has commenced. The construction of the "Internal drainage" is expected to be finished before the rains. The "Outfall drain" has been postponed pending final sanction to the drainage project of the whole city.

5. *Benares*.—The pumping plant at the filtered and unfiltered water stations worked well throughout the year and the machinery kept in proper order. The hours of pumping have been very long, averaging 23·45 hours daily when compared with the last year's average which was 21·26 hours daily. There were only two accidents at the unfiltered station Bhadaini, but the water supply was not stopped. Settling tank No. 2 and filter No. 7, the two Clear Water Reservoirs and the Raised Reservoir were also thoroughly cleaned during the year.

Two extensions of pipe line were carried out during the year. The construction of the new filter No. 8 is almost complete. The boiler at the filtered station Bhelupura has been renewed and provision has also been made for one more boiler for this station. A revised estimate has been sanctioned for the new Rising Main from the unfiltered station to the settling tanks of the filtered station and the work is being pushed on. The proposal for one new engine at the unfiltered station Bhadaini has been sanctioned and tender of Messrs. Simpson & Co. accepted. A fourth settling tank appears to be necessary and probably two filters will be required, but this question will be considered later on.

The consumption of filtered water was 1,474 million gallons against 1,467 millions of the last year. The maintenance charges amount to Rs. 88,479 equivalent to an average cost of ·95 anna per 1,000 gallons of filtered water, the daily average consumption of water per head being 19·0 gallons. The income from water rate and other receipts is Rs. 1,02,227, which exceeds the expenditure by Rs. 13,748.

The total number of house connections is 6,535 or 357 more than those of the last year.

No sewerage works were undertaken during the year under report. Three thousand six hundred and sixty-nine feet of drains left unfinished at the close of the last year were completed during the year under report, and some 2,590 L. ft. of small size stoneware pipe branch sewers were laid, and the whole of the main and branch sewers were systematically inspected and flushed and were in excellent order.

One new 48-seated automatic flushed latrine and a pail dépôt were constructed. The purification arrangements at Chowkaghat latrine have worked satisfactorily, and a small amount of cultivation has been carried out with success and further land is required for larger operations.

6. *Cawnpore*.—The pumping plant has worked well throughout the year. All the main pump valve seatings were taken out, refaced and a number of new seatings put in. The new pump plungers with new gun-metal sleeves and a new set of main pump valves with spindles and caps were also fixed. Both engines are now fitted with air balances and are working satisfactorily. They are being worked together to keep up the supply. There was an increase in the filtered water supply of nearly 128 million gallons to the town.

Filters Nos. 1, 3 and 5 and three settling tanks were cleaned and sand in the former was renewed.

The workshops have been busy during the year on repairs to meters, and the engines of the three pumping stations; three steam road rollers, conservancy locomotive engines and distribution valves and fittings were also repaired.

All the boilers to the different engines were examined and passed by the Government Boiler Inspector.

Urgent necessity for improving and increasing the present water supply of the town has been advocated by Mr. Aikman on the ground that during the hot weather all the pumping engines at both the unfiltered and filtered stations have to work for about 18 hours together to cope with the supply, and as there is no spare plant in case of accident, it is very necessary that more pumping power should be provided at both the stations. This question of increasing the pumping plant is under consideration.

The expenditure on the maintenance of the water works during the year was Rs. 1,00,542 against Rs. 1,11,474 of last year. This saving is due to there having been no expenditure on making a channel in the bed of the river to the pump wells.

The cost of filtered water per 1,000 gallons works out to 1·2 annas against 1·5 of last year; the average consumption of water per head being nearly 20·50 gallons (this consumption includes road watering, flushing drains and sewers).

During the year, 1,505 feet of 4" cast-iron mains on LaTouche Road and 288 of 3" main in Gwaltoli were laid. Also 13 road watering stand-posts and one hydrant in Gwaltoli were fixed; 224 service connections were made with the mains, of which 175 were for domestic purposes and 49 for gardens and manufacturing purposes, against 136 and 47 in the previous year. The total connections made for domestic purposes up to the close of the year numbered 1,629.

The amount realized by the sale of water and other receipts during the year amounted to Rs. 58,155 against Rs. 30,538 of the last year.

The latrines, pail and filth cart dépôts have worked satisfactorily and there has been no block in any of the sewage piped system. The covering over the arched portion of the Sissamau nala with street sweepings is nearly completed.

An estimate amounting to Rs. 16,216 was sanctioned for paving and draining the Kursawn Mohal and the work was about to be taken in hand.

Surveys and levels for the whole of the city drainage are being prepared.

7. *Lucknow*.—The pumping machinery has worked well throughout the year and is carefully looked after. The settling tanks and filters were thoroughly cleaned out and repaired. The quality of water was excellent; 228 house connections were made during the year, the total number coming up to 1,210.

The total quantity of filtered water pumped to the town was 761 million gallons, which shows an increase of 83 million gallons over last year. The engines at Gaughat have worked on an average 14·7, and those at Aishbagh, 11·7 hours per day. The working charges for the year amount to Rs. 49,896 and the total income from water rate, sale of water and other receipts is Rs. 85,280, the excess of revenue over expenditure being Rs. 35,384. The cost of 1,000 gallons of filtered water per head comes to 1·02 annas, the average consumption of filtered water per head being 7·8 gallons. Four thousand six hundred and twenty feet of extensions of pipe line were carried out during the year, and 13 stand-posts, 17 hydrants and 7 sluice valves were erected at a cost of Rs. 13,184, and Rs. 3,941 was spent on a new Compressed Air Balance for Gaughat.

The Maulviganj and Pata Nala drainage are almost complete, the total expenditure on the same being Rs. 82,841-8-6.

8. *Meerut*.—The Meerut water works give the best quality of water in the provinces as the samples of water tested chemically, bacteriologically and qualitatively show very good results. The filters worked most satisfactorily during the year, and the pumping machinery was maintained in good order. The consumption of water has risen from 224 million gallons of the last year to 265 million gallons which is due to the increase in the number of house connections. The working charges amount to Rs. 23,187 and the receipts from sale of water are Rs. 33,352, thus showing a credit balance of Rs. 10,165. The cost of 1,000 gallons of filtered water comes to 1·4 annas, the average consumption of water per head being 6·0 gallons.

The proposed extensions to the Meerut College, the Police Lines and the Canal Offices have received administrative sanction. The former two have been completed and the third one is under execution.

9. *Mussooree*.—The water works have worked satisfactorily during the year. The maintenance charges work out to Rs. 26,389 against Rs. 22,704, and the consumption of water has increased by nearly two million gallons over the last year. The hydro-electric scheme for extending the water works and electric lighting to Mussooree is still under construction, and will most likely be ready for the next hot weather. The revised estimate is still under consideration and has not been sanctioned yet. The total amount spent during the year was Rs. 4,58,781.

10. *Naini Tal*.—The pumping machinery was in good order and worked satisfactorily throughout the year. The maintenance charges amounted to Rs. 35,309 against Rs. 34,227 in last year, the excess being due to extra pumping of nearly 1½ million gallons and to the cost of a new superheater bought to replace the one cracked last year.

The Boiler Inspector tested the boiler and the superheater and passed them. The quality of the water has been good. The income from water rate, sale of water and other receipts is Rs. 29,419 and the number of house connections has come up to 111.

GENERAL.

The consumption of water is increasing fast and in some cases it is due to increase of population and legitimate expansion. But in several cases such as Agra, Cawnpore, Allahabad and Benares, even taking into consideration the drainage and sewerage system of these places, the average consumption is higher than it should be when compared with places like Lucknow and Meerut. Where the supply to the

gardens and houses is metered, and payment is made by actual measurement, the municipalities derive a certain revenue out of the water sold, but in cases of house connections which are not metered, there seems to be no doubt that the water is illegitimately used and wasted.

Leaving out Meerut and Lucknow where the average consumption is very moderate, the nature of the receipts of the other four important water works are as follows :—

Name of station.	House connections for purely domestic purposes.	Metered connections.	The consumption per capita for domestic purposes.	Water rate.	Sale of water.
			Gals.	Rs.	Rs.
Agra ...	1,188	74	13 4	66,818	45,422
Cawnpore ...	1,312	317	20 50 12 7	Cawnpore has no water rate. The water works get an allotment from the amount collected in railway terminal tax.	51,392
Allahabad ...	2,233	271	12 7 20 50	87,245	31,259
Benares ...	6,507	4	19 0	97,763	5,751

It is true that Cawnpore and Benares have extensive sewerage system and surface drainage while Agra and Allahabad have not to the same extent, but still considering the number of house connections which are not metered, there must be a good deal of waste or illegitimate use of water in all these places and before any expansion of the water works is proposed, the municipalities might as well find out where the waste occurs, by careful inspection of these house connections and by the introduction of more meters if necessary. Lucknow, which has a good deal of surface drainage and some sewer, only consumes 7 8, and there seems no reason why the consumption at Agra and Allahabad, should not be brought down to the same amount, and that at Cawnpore and Benares should be more than double that quantity. At both the unfiltered and filtered stations of all these water works no accurate means of gauging the delivery of the pumps exists, it is just as well that Venturi meters should be provided at both the unfiltered and filtered pumping stations so that the volume of water delivered by the pumps may be accurately recorded. The present method of ascertaining the same by measuring the water pumped into the settling tanks for the unfiltered supply, and from the Clear Water Reservoir for the filtered supply must necessarily be liable to error.

The cost of raising 1,000 gallons 100 feet is lowest at Lucknow, where it works to 0·53 anna, and I think that the cost at Cawnpore, Allahabad and Benares is capable of improvement; the cost at Meerut, considering the power used, is distinctly high, and points to the fact that extension there is legitimate, so as to make full use of the establishment and contingent charges which are permanent recurring charges.

DRAINAGE WORKS.

These were completed in Deoband and Nagina, and those at Hathras are under construction.

Projects for the drainage of Saharanpur, Muttra, Jaunpur, Budann, Ujhani, Moradabad and Khurja were completed, but most of these are being revised or recast to a certain extent. Drainage projects for Hapur, Fyzabad, Bahraich, Ghazipur and Allahabad have also been completed but have not come up before the Sanitary Board for sanction.

Surveys for Mainpuri, Amroha, Etawah, Gorakhpur, Sambhal, Jhansi and Shahjahanpur are being made for the preparation of necessary drainage schemes.

Mr. H. E. Parker was appointed to the post of Assistant Sanitary Engineer in January 1907, and was engaged during the year on the following works :—

- (a) Preparation and supervision of work of the Chhapakhana improvement scheme, Meerut, the estimate of which amounted to Rs. 26,500.
- (b) Revision of the Delhra water supply scheme. The original estimate for the extension of the pipe line here was for Rs. 56,000, but it had to be revised as the authorities would not allow the pipes to pass through the cantonment. An estimate for bringing water to the Dun Court is also under preparation.
- (c) Supervision of the Nagina drainage works.
- (d) Preparation of an estimate for the Sardhana main drain.
- (e) Making of arrangement for water supply at Najibabad in the Bijnor district.

INSPECTION OF BOILERS.

During the year under report 646 boilers and 652 prime movers were inspected and licensed; the revenue for the year being as follows:—

				Rs.	a.	p.
Boiler fees	...	...	...	20,430	13	4
Prime mover fees	...	...	...	3,587	15	8
Miscellaneous receipts	...	...	...	217	7	0
Total	...	...	...	24,234	4	0

As observed in the last year's report the reduction of fee on Prime Movers has resulted in a decrease of Rs. 1,058 in revenue. There has, however, been an increase of Rs. 3,389-8-4 in the fees realized by inspection of boilers owing to an addition of 73 new boilers during the year.

The expenditure for the year is Rs. 17,239-0-4 and the income shows a credit balance of Rs. 6,997-3-8 which added to the balance of former years, brings the total sum to the credit of the Department, to Rs. 33,995-10-1.

Sixteen certificates of boilers and prime movers were, under section 9(1) of the North-Western Provinces and Oudh Steam Boilers and Prime Movers Act, I of 1899, issued on Engineers' reports and the one quarter fee realized on account of them amounts to Rs. 154 which is included in the above receipts.

An accident causing one death occurred in the factory of Harcharan Das Daulat Ram at Harduaganj on 5th December 1907, and was communicated to the Boiler Inspector's office by the Special Inspector of Factories on 23rd December 1907.

Board of Examining Engineers.—Nine meetings of the Board of Examining Engineers were held during the year and the following certificates were granted :—

1st class competency certificates	4
2nd class competency certificates	11
1st class service certificates	12
2nd class service certificates	28
1st class Engine Drivers' certificates	58
2nd class Engine Drivers' certificates	62
Transfer certificates on certificates from other Provinces	27
Total	202

ALLAHABAD:	} A. W. E. STANDLEY, <i>Supdg. Engr.,</i> <i>Sanitary Engineer to Government, United Provinces.</i>
The 3rd May 1908.	

APPENDICES.

APPENDIX No. I.

UNITED PROVINCES WATER WORKS.

Statement of operations during the year 1907-1908.

	Agra.	Allahabad.	Benares.	Cawnpore.	Lucknow.	Meerut.	Mussooree.	Naini Tal.
<i>Population.</i>								
By census of 1901 in Municipality ...	165,981	153,515	208,121	172,674	210,568	78,740	*14,039	*14,220
By census of 1901 in Cantonments ...	22,041	12,487	4,953	24,496	23,407	39,389	3,711	944
Number of inhabitants drawing their supply from mains.	188,022	172,032	203,174	172,674	233,824	118,129	14,689	15,164
<i>Consumption of water.</i>								
During the year including Cantonments, Gallons	1,014,024,857	840,673,277	1,474,810,700	1,326,310,325	761,222,455	265,004,621	75,0444	37,024,135
Daily average including Cantonments ...	2,779,558	2,290,921	4,026,555	3,679,044	2,070,842	727,848	31,816	103,244
Maximum daily average in any one month	3,025,038	3,345,830	5,192,504	4,240,000	2,933,812	1,214,760	37,441	155,316
Water used for irrigation and manufacturing purposes.	93,469,000	41,465,000	17,262,808	20,805,000	10,713,820	3,855,924	Nil	198,690
Water used for domestic purposes ...	920,615,857	796,208,277	1,457,547,891	1,305,505,325	750,508,635	261,809,297	75,0444	37,024,135
Water consumed per capita.	13.4 gallons	12.7 gallons	19.0 gallons	20.20 gallons	7.8 gallons	6.0 gallons	1.4 gallons	6.7 gallons
Daily average for Cantonments alone ...	315,492	193,257	Nil	Nil	305,111	55,008	Nil	1,550
<i>Annual receipts and charges.</i>								
Maintenance charges ...	88,526	74,219	88,479	100,542	10,893	23,187	16,869	35,300
Cost per 1,000 gallons consumed ...	1.89 annas	1.4 annas	.95 annas	1.2 annas	1.02 annas	1.4 annas	3.5 annas	Rs. 0.95
Cost per 1,000 gallons per 100 feet lift	0.85 "	0.76 "	.65 "	0.82 "	.58 "	1.1 "	Rs. 0.23	{ H.L. 0.03 L.L. 0.18
<i>Lift of pump.</i>								
From river to settling tanks ...	85' to 40'	100-83'	81.1'	80.7'	100'	1510'	600'	†
From filtered water pumps to town distribution ...	125' to 180'	72-02'	11.65'	6.36'	81.4'	118.25'	to reservoirs	†
Total lift	160' to 170'	173-35'	115.82'	117.06'	190.4'	128.41'	600'	...
<i>Income from water works.</i>								
Water rate recovered during the year	66,818	87,248	94,773	No rate	27,553	Nil	...	26,049
Sale of water and other receipts ...	46,523	32,032	7,494	58,175	57,727	33,352	...	3,370
Total income	1,13,344	1,23,270	1,02,267	35,455	35,280	33,852	...	29,419

* Summer residential population. † Cold weather residential population. ‡ H.L. Naini Tal, 1907.

† Lift of pump from springs to reservoirs, Allahabad, 100 feet; Benares, 110 feet; Lucknow, 110 feet; Meerut, 110 feet.

APPENDIX No. II

Annual maintenance accounts of water works in the United Provinces during the year 1907-1908.

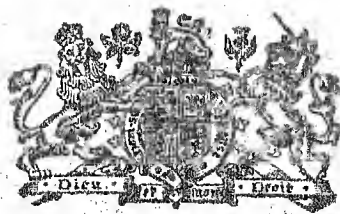
Nature of charge.	Agra.	Allahabad.	Benares.	Cawnpore.	Lucknow.	Meerut.	Mussoorie.	Naini Tal.
1. Establishment—								
(a) Permanent establishment	Rs. 52,010	Rs. 21,522	Rs. 25,401	Rs. 22,881	Rs. 19,913	Rs. 10,011	Rs. 3,948	Rs. 9,145
(b) Office contingencies	2,151	472	687	517	424	4,960	162	100
(c) Rent	..	1,700	231	..	420	360	Nil	420
2. Pumping—								
(a) Coals	30,113	15,916	13,290	54,781	19,938	571	20,186	14,183
(b) Oil and waste	2,204	1,354	2,506	4,094	665	884	1,397	512
(c) Other stores	2,571	2,263	2,522	4,956	1,735	2,147	..	1,000
3. Intake—								
(a) Training river	1,433	Nil	..	6,240	..	..	..	..
(b) Clearing channels and wells	3,023	62	140	..	793	38	..	..
4. Settling tanks and filters—								
(a) Clearing settling tanks	404	2,380	510	..	300	50	..	..
(b) Clearing and renewing filter beds	7,120	2,671	3,122	7,617	2,860	1,590	..	..
(c) Purchase of sand	5,000	2,450	..	5,252	10	..	..	..
(d) Distribution—								
(a) Pipes and fittings	3,500	4,986	5,312	3,332	1,312	1,202	..	5,406
(b) Meters	202	8,314	6	4,725	..	..	..	1,437
5. Repairs—								
(a) To tanks	409	90	11	..	115	..	..	..
(b) To buildings and grounds	1,502	813	762	1,536	622	114	554	2,059
(c) To machinery	5,003	1,877	6,755	3,606	923	..	..	500
6. Water analysis—	880	1,129	972	1,083	240	760	110	517
Total	88,526	74,219	88,479	1,00,512	49,896	23,187	20,389	25,369

* Cost of coal per ton ...

Agra	14 5
Allahabad	10 7
Benares	11 6
Cawnpore	11 0
Lucknow	11 5
Meerut	11 5
Mussoorie	11 0
Naini Tal	11 0

TWELFTH ANNUAL REPORT
OF THE
SANITARY ENGINEER
TO
GOVERNMENT, UNITED PROVINCES,

FOR THE YEAR ENDING 31st MARCH 1907.



A L L A H A B A D :

Printed at the United Provinces Government Press.

1 9 0 7.

Twelfth Annual Report of the Sanitary Engineer to Government, United Provinces, for the year ending 31st March 1907.

THE post of the Sanitary Engineer to Government, United Provinces, was held throughout the year by Mr. D. W. Aikman, Superintending Engineer, Public Works Department.

2. Besides the eight water works stations, the Sanitary Engineer visited, during the year under report, Azamgarh, Ballia, Bareilly, Chandauli, Dohra Dun, Delhi, Deoband, Farukhabad, Fatehgarh, Fyzabad, Jhansi, Mampur, Mirzapur, Moradabad, Mussoorie, Nagina, Saharapur, Simla and Soron, most of these places twice or thrice, for the purpose of inspecting works and advising municipalities on sanitary schemes.

3. *Agra.*—The pumping machinery has worked well throughout the year. The beam engines have got ample spare parts and the New High Duty Worthington Engine, ordered last year, has been erected and is working satisfactorily. The New Rider Main mentioned as contemplated in my last Annual Report, is finished at a cost of one lakh and the water supply has been extended to Taj Ganj at a cost of Rs. 15,000 granted by Government.

One new filter No. 6 has been completed and this will enable the Board to meet the great demand in the hot weather, it being expected that the Railways will require about 75 million gallons of water next year.

Two State visits came on during the year under report, making a very large extra demand on the water supply which was successfully met, reflecting credit on Mr. Rogers, the able Secretary-Engineer, for his arrangements, and on his subordinate staff who worked so willingly during the long hours required to meet this extra demand.

The quality of water was excellent throughout the year.

No bursts or accidents occurred to the pipe line.

The income from water rate, sale of water and other receipts, is Rs. 98,502 and shows a balance over expenditure of Rs. 15,432 or about double that of last year. The cost of 1,000 gallons of filtered water works out to 1.45 annas against 1.49 annas of last year.

Fifteen more lanes have been paved and drained during the year. The mileage of drain flushing has risen to 42½ miles. The intercepting sewer continues to work well and the sullage farm is a great success, being quite inoffensive. The crops of tobacco, garlic, wheat, barley and vegetables are very good. The latter gaining 1st prize at the Taj Horticultural Show this year.

4. *Allahabad.*—The pumping plant at both stations has worked satisfactorily and the boilers are kept in good order. The supply of spare parts is sufficient and is well kept.

The number of house connections is increasing every year and this year it has reached 2,292. The consumption of water is a little less than last year. The income from water rate and other receipts is Rs. 1,24,822 and is nearly double the amount of maintenance charges which are Rs. 64,531. The cost of 1,000 gallons of filtered water is 1.31 annas.

A proposal for an unfiltered water supply for public and private gardens at Allahabad estimated to cost Rs. 4,75,000 is under the consideration of Government. This plant will give, in addition to irrigation water, a maximum of one million gallons a day of unfiltered water during the hot weather to the water works. Then by the addition of a small filtered water pumping plant to pump separately into the 18" main supplying the Cantonments, Civil Lines and Katra, the existing engines will be ample to meet the increasing city supply for some time to come.

14,814 feet of flag stone drains were laid, 46,000 square feet of city lanes paved. One new latrine erected, 15 old latrines replaced with new ones; improvements to Cantonment drains were carried out and an engine and a disintegrator purchased for the large drainage scheme which is under preparation. The total expenditure incurred on the above works amounts to about Rs. 40,000.

5. *Benares.*—The pumping plant at the filtered water station has worked well throughout the year and the machinery has been carefully looked after. There were three accidents to the unfiltered pumping plant, the first occurred to E pump rods on 20th November 1906, a second to D pump connecting rod bolts on 20th December 1906, and a third to D pump again on 24th December 1906. All of these were put right without delay and there was no stoppage of water. Com pounds, buildings and gardens have all been kept in good order.

Three extensions of the pipe line were carried out during the year. The construction of the new filter is being pushed on and will soon be completed. Provision has been made for an additional boiler at filtered station Bhelupura. A new rising main from the unfiltered station to the settling tanks has been sanctioned and arrangements are being made for one engine and two boilers for the unfiltered station. The present unfiltered plant, as the frequent accidents show, is nearly worn and has now become unreliable, and the proposed new pumping plant is very necessary.

The consumption of filtered water was 1,467 million gallons against 1,393 millions of last year. The maintenance charges amount to Rs. 75,955 which gives an average cost of 83 anna for 1,000 gallons of filtered water, the average consumption per head being a little over 19 gallons. The income from water rate and other receipts is Rs. 1,02,654 which gives a balance of Rs. 26,700 over expenditure. The total number of house connections is 6,178 or 319 more than last year.

The sewerage works for the sewered area which were commenced in 1893 have been completed at a total cost of Rs. 13,32,033 or Rs. 32,033 more than the original estimated cost. There is Rs. 80,000 worth of stock, tools and plant belonging to the municipality, and a large amount of extra work has been carried out from savings and revenue.

A comprehensive project amounting to Rs. 20,72,953 for completion of the sewerage and surface drainage of the rest of the city has been prepared and sanctioned. This estimate is much beyond the present resources of the municipality but will be carried out as funds admit.

6. *Cawnpore.*—The pumping plant has worked well throughout the year. The main pump valve seatings have been taken out and refaced. A new set of pump valves have been put in with new springs. Two new balance arms have been fixed. On the 2nd December 1906, the main pump rod of No. 1 unfiltered water engine broke near the pump plunger at the taper, causing the breakage of the three arm balance lever and the high pressure piston. These were replaced and a new set of piston rings put into the cylinders. The boilers at both stations have worked satisfactorily and are regularly examined by the Government Boiler Inspector. Owing to the increased demand for filtered water, it is found in the hot weather that the present filtered water pumping engines working together are unable to keep up the required pressures. Proposals for an additional pumping plant at both pumping stations are about to be made.

During the year 2,800 feet of 4 inches cast iron pipe water mains have been laid along the Orphanage Road at the cost of Government and 945 feet of 3 inches cast iron mains have also been laid along the Nawabganj Road. 183 service connections were made during the year, and the total number of connections up to date is 1,405.

The total consumption of water pumped to the town was 1,193 million gallons against 1,118 millions of last year. The maintenance charges have gone up to Rs. 1,11,474 against Rs. 89,983 in the previous year, the increase being due to extra expenditure for meters and new valves for engines and river training at the intake due to the river going over to the far side.

There is no water rate in Cawnpore and the sales of water and other receipts amounted to Rs. 30,538. The cost of filtered water per 1,000 gallons comes to 15 annas, the average consumption of water per head being nearly 19 gallons.

The latrines, pail and cart depôts have worked satisfactorily. The arching over of the Sisamau storm water nala has been completed for a length of 1,306-feet. The arched nala is being covered over with the view of constructing a roadway over it. Additional branch pipe sewers along roads Nos. 45, 48 and 3 have been constructed and pipe sewer connections have been made with Flour Mills, Sugar Works, Mission Church and Victoria Mills.

The low level sewer engines and pumps have worked satisfactorily. During the year estimates and plans have been prepared and levels taken for the surface drainage and lane paving of the city.

7. *Lucknow*.—The pumping machinery has worked well throughout the year and is carefully looked after. The settling tanks and filters have been kept in thorough repairs. The quality of water was excellent; 201 house connections were made during the year, the total reaching 982.

The total quantity of filtered water pumped to the town is 678 million gallons. The working charges amount to Rs. 55,791 and the income from water rate, sales of water and other receipts is Rs. 83,678, thus showing a balance of Rs. 27,887 over expenditure. The cost of 1,000 gallons of filtered water works out to 1.31 annas, the average consumption of filtered water per head being 7 gallons. The distribution pipes at Lucknow are still far from supplying all the inhabited portions of Lucknow. If the still unsupplied portion be deducted the consumption per head will be nearly 12 gallons per day.

Surface Drainage Works.—A large quantity of surface drainage and lane paving has been done during the year. The total expenditure up to date being over 6 lakhs. The experimental sullage purification plant is now giving such good results that there is no doubt in my mind of its ultimate complete success.

8. *Meerut*.—These water works give the best quality of water in the Provinces. The average number of microbes per c. c. out of 183 samples works out to only 3.7. The consumption of water is 221 million gallons against 209 of last year. The working charges amount to Rs. 23,538 and the receipts from sale of water are Rs. 32,861, thus showing a credit balance of Rs. 9,323. The cost of 1,000 gallons of filtered water comes to 1.68 annas, the average consumption per head being 5.2 gallons. The strong prejudice in Meerut among the city inhabitants against using pipe water is gradually becoming less; the increased consumption this year is satisfactory.

9. *Mussoorie*.—The large Hydro-electric scheme for extending the water works and electric lighting to Mussoorie and Landour is in progress and is expected to be completed by March 1908. Rs. 2,31,765 have been spent on this scheme up to date.

The maintenance charges for water works amount to Rs. 22,704, and the consumption of pumped water is 7,358,561 gallons.

10. *Naini Tal*.—The pumping machinery is in good order and has worked satisfactorily throughout the year. The superheater of boiler No. 2 cracked through exposure to the cold. In April 1906, the boiler house iron chimney collapsed, but it was promptly temporarily repaired, and has now been replaced by a new chimney. The maintenance charges amount to Rs. 34,227, and include the cost of a new chimney and additional cost of making and fitting a temporary one. The income from water rate, sale of water and other receipts is Rs. 30,190 which nearly balances the ordinary expenditure.

The heading of the Ransi Gorge tunnel was completed in May 1906, without any accident occurring to the workmen. This was an exceedingly difficult piece of work and great credit is due to Mr. Peaks who carried it out.

Drainage works.

These were completed in Dehra Dun, Chandausi, Fatehgarh and Mirzapur. In Deoband and Nagina the work is nearing completion. In Lucknow the total amount spent up to date on drainage works is Rs. 6,64,629 including that spent on biological filter construction. The major portion of Moulviganj is completed and three-fourths of the work on Pata Nala section is finished. A comprehensive project for a complete drainage scheme for Lucknow amounting to Rs. 18,51,545 (excluding Moulviganj and Pata Nala) has been approved by the Sanitary Board and is awaiting the sanction of Government.

Projects for the drainage of Hathras, Budaun, Moradabad, Hapur, Saharanpur, Bahraich, Jaunpur, Fyzabad, Ujhaini, and Muttra and Brindaban have been completed or are nearing completion.

Surveys are in progress in Amroha, Etawah, Gorakhpur, Mainpuri and Sambhal.

The appointment of an Assistant Sanitary Engineer to Government, United Provinces, was sanctioned by the Secretary of State for India, and Mr. H. E. Parker has been appointed to the post. He joined in January 1907.

Inspection of Boilers.—During the year under report 760 boilers and 724 prime movers were inspected. The revenue for the year is as follows:—

	Rs.	a.	p.	Rs.	a.	p.
Boiler fees ...	17,041	5	0			
Prime mover fees ...	7,722	11	4			
Mi-cellaneous receipts ...	530	9	0			
				25,294	12	4

There is a decrease of Rs. 316-3-8 from the income of last year, in spite of increased number of boilers and prime movers inspected, and this is due to the fee on prime movers being considerably reduced. This reduction will still further decrease the receipts for next year, as this year the reduction was only enforced from November last.

The expenditure for the year is Rs. 17,347 and the income shows a credit balance of Rs. 7,947 which added to the balance of former years, brings the total sum to the credit of the Department to Rs. 27,000. I consider that the fees charged for prime movers may now be removed entirely or a reduction made in the fee for boiler inspections whichever is considered most desirable. The Upper India Chamber of Commerce might be consulted.

Board of Examining Engineers under the Boiler Act.—Nine meetings of the Board were held during the year and the following certificates were granted:—

1st class competency certificates ...	11
2nd ditto ditto ...	23
1st class service certificates ...	21
2nd ditto ditto ...	29
1st class Engine Drivers' certificates ..	60
2nd ditto ditto ...	60
Total ...	207

General.—The experiments referred to in last year's report on the purification of sewage and sullage have been continued throughout the year with most encouraging results.

Sewage treatment.—A 48-seated latrine was erected at Chaulaghat, Benares, and is used daily by over 2,000 inhabitants. The latrine is automatically flushed. The sewage is first treated in a biological tank where all solids are broken down by bacterial action. The size of this tank has been regulated as far as possible so as to allow the greatest amount of biological action to take place without reaching the purificative stage. The effluent from the biological tank is further treated in the following ways:—

- (1) by running it on to land and cropping the land. This proved very successful and will be adopted where there is sufficient land at the site of the latrine to crop in rotation without danger of rendering it sewage sick;
- (2) by a trickling filter provided with a Fiddian distributor. The effluent from this was generally very good but varied from time to time. The filter clogged occasionally and required attention. The effluent was best just before the filter clogged and worst when restarted;
- (3) by single and double contact filters. This gave very excellent and uniform results. Both these methods require carefully trained supervision. Experience has shown that intelligent sweepers, when thoroughly trained, are quite efficient;
- (4) by trickling filters fed through spraying nozzles. This has not yet been tried on latrine effluents but gave good results with sullage, and will shortly be tried at Chaulaghat latrine or elsewhere.

Sullage treatment.—The artificial purification of sullage as distinct from sewage, as far as I know, has not previously been tried on a large scale, although it has successfully been treated, by natural means, on land at Agra and elsewhere, but in many places in the plains neither is there sufficient land available nor do the levels suit. The necessity for purifying sullage, especially in the case of a large town discharging its sullage into a small river is obvious. Sullage contains a large portion of mineral matter, dyes and other trade refuse which renders the sewage of manufacturing towns in England so difficult to treat. Its constitution has been found to vary to an enormous extent from day to day, from hour to hour and also from town to town. It is very concentrated, amounting to as much as

144 times the strength of normal sewage at home. It will, therefore, be evident that, in attempts to purify discharges of such a character, which, owing to the small amount of animal matter, is of a foul but attenuated composition so far as bacterial action is concerned, we are undertaking a work of far more difficulty than has hitherto been contemplated.

The following comparison of analyses of the results obtained from the large experimental purificative works at Lucknow with those of the well known Tame and Rea works where the sewage of Birmingham is purified and which are considered about the best and most up to date, will, I think, show we are now within measurable distance of entire success and when further means are taken for the more complete exclusion of mineral matter, which hampers to a great degree the processes of purification, and when sufficient self-purifying latrines are made to discharge into the surface drains and to contribute a balance of animal matter, the result will, I trust, at least equal the best result at home.

Table of analyses comparing the composition of the Birmingham sewage and effluent with those of Lucknow sullage and the effluents from double contact treatment, Piddian and sparging nozzle trickling filters.

Results expressed in parts per 100,000.

Nature of sample	Suspended solids.	Free ammonia	Albuminoid ammonia	Nitrates and nitrites as nitrogen.	Oxygen absorbed	Remarks.
Birmingham crude sewage...	71.4	4.947	1.716	0.893	17.169	} Compare these.
Lucknow crude sullage ...	416.0	15.8	0.54	1.81	5.684	
Lucknow sullage effluent---						* Not given by Government Analyst. Ditto.
(i) after double contact ...	19.6	1.34	0.21	4.91	2.86	
(ii) from Piddian sprinkling filter.	26.5	2.86	0.138	*	1.940	
(iii) from nozzle sprinkling filter.	3.0	1.78	0.30	*	2.82	} Compare these.
Average Lucknow effluent to date.	16.37	1.99	0.216	4.91	2.54	
Birmingham effluent after passing through bacteria bed, average of 3 months	7.0	3.471	0.33	2.112	2.525	

It has been stated that the new works of surface drainage at Lucknow will contaminate the river to a greater extent than previously, but the above analyses will show that this is not so even with the works only in an experimental state.

Proposals have also been brought forward for an intercepting sewer at Lucknow to convey the whole of the sullage and storm water below the town. However advisable, this, from engineering and financial difficulties, is not feasible, and indeed the measure of success already obtained with purification is sufficient guarantee that an intercepting sewer will be unnecessary.

D. W. AIKMAN,

*Superintending Engineer,
Sanitary Engineer to Government,
United Provinces.*

NAINI TAL :

The 8th May 1907.

APPENDIX.

APPENDIX

UNITED PROVINCES

Statement of Operations

	Agia	Allahabad	Bonares
<i>Population.</i>			
By Census of 1901 in Municipality . .	165,981	159,545	204,373
Ditto ditto Cantonments ...	22,041	12,437	4,959
Total ...	188,022	172,032	209,331
<i>Cost of Works</i>			
Initial capital cost Rs.	11,70,761	16,24,061	25,61,881
Cost of extensions and improvements to end of previous year. "	3,26,215	1,33,113	1,54,583
Ditto ditto during year ... "	2,11,790	15,270	4,295
Total Cost of Works ... "	17,08,766	17,72,444	27,20,759
<i>Consumption of filtered water.</i>			
During year including Cantonments . Gallons	914,643,200	787,750,868	1,467,718,112
Daily average ditto ... "	2,505,871	2,158,495	4,021,145
Maximum daily average in any one month "	2,869,203	3,061,243	4,585,661
Daily average for Cantonments alone .. "	289,800	220,725	1,325
Average number of hours filtered water pumped daily.	8.97	11.84	9.60
<i>Annual Charges and Receipts.</i>			
Maintenance charges Rs.	83,070	64,531	75,953
Total charges with interest and payment of loan.	1,70,316	1,72,218	1,61,161
<i>Income from Water Works.</i>			
Water rate recovered during year ...Rs.	61,707	88,024	94,286
Sales of water and other receipts .. "	36,795	36,798	8,368
Total Income ... "	98,502	1,21,822	1,02,654
<i>Number of house connections at end of year.</i>			
For purely domestic purposes	1,164	2,142	6,115
For other purposes	104	150	63
Total ...	1,268	2,292	6,178
Number of connections with meters .	77	245	63

No. 1.

WATER WORKS.

during the year 1906-1907

Cawnpore.	Lucknow	Meerut.	Mussoorie.	Main Tot
172,674	240,568	78,740	14,689	14,220
24,496	23,407	39,389	3,711	944
197,170	263,975	118,129	18,400	15,164
11,41,353	15,15,736	7,51,710	73,045	2,47,000
2,92,348	1,41,015	Nil	Nil ...	2,94,876
9,452	2,544	...	2,31,765	...
17,43,153	16,59,295	7,51,710	3,04,810	5,41,876
1,193,008,879	678,006,008	223,973,383	*7,358,561	29,103,380
3,268,517	1,857,550	613,626	39,142	79,735
4,400,000	2,648,696	1,228,958	43,795	173,182
...	321,366	273,851	Nil ...	1,667
17.10	9.9	13.60	20.32	11.5
1,11,474	55,791	23,533	22,704	34,227
1,65,464	1,31,737	66,670	25,512	57,241
...	27,833	Nil ...	Nil ...	26,353
30,536	55,845	†32,861	...	3,837
30,538	83,678	32,861	Nil ...	30,190
1,137	908	280	...	96
268	74	4	...	7
1,405	982	231	Nil ...	103
247	79	15	Nil ...	102

* Excluding cantonment.

† Including Rs. 30,000 from cantonment.

ELEVENTH ANNUAL REPORT
OF THE
SANITARY ENGINEER

GOVERNMENT, UNITED PROVINCES

FOR THE YEAR ENDING 31st MARCH 1906.



ALLAHABAD:

Printed at the United Provinces Government Press.

1906

Eleventh Annual Report of the Sanitary Engineer to Government, United Provinces, for the year ending 31st March 1906.

The post of Sanitary Engineer to Government, United Provinces, was held throughout the year by Mr. D. W. Atkman, Superintending Engineer, Public Works Department.

2. During the year under report, the Sanitary Engineer visited, besides the eight water works stations, Aligarh, Amroha, Bareilly, Budaun, Bahraich, Chandausi, Dehra Dun, Fyzabad, Fatehgarh, Farrukhabad, Ghazipur, Gorakhpur, Gonda, Hapur, Hathras, Hardoi, Muzaffarpur, Moradabad, Nanpara, Orai, Saharanpur, Shahjahanpur, Sambhal and Ujhani, most of these places twice or thrice, for the purpose of inspecting works and advising municipalities on sanitary schemes.

3. *Agra*—The pumping machinery has worked well throughout the year. The old beam engines have been thoroughly overhauled and are in good working condition. The boilers are kept in first class order. A new high duty Worthington engine to cost Rs. 99,000 (with building and connections) has been ordered from Messrs. Simpson and Co. and a new Rider Main is contemplated. The house for the new engine is ready and the engine has arrived in India and will be erected during May. The stock of spare parts is carefully maintained.

The extension of the clear water reservoir as well as the new fifth filter is completed and is in use. The quality of water was excellent and its consumption has risen by 20 per cent. over last year. The Commissioner is in correspondence with the Irrigation Department with a view to supply unfiltered water for road watering, drain flushing and garden irrigation. This, if found possible and practicable, would be a great relief to the water works.

The income from water rate, sale of water and other receipts is Rs. 96,607 and shows a balance of Rs. 8,687 over maintenance charges. During the year there were 130 house connections which is 50 per cent. above the average for the last five years.

The saving in coal amounting to Rs. 7,000 is very satisfactory and is due to a considerable extent to Mr. Roger's patent mica composition and his careful management.

The cost of 1,000 gallons of filtered water works out to 1.49 annas against 1.55 annas of last year.

The intercepting sewer is finished and works well. Sixteen lanes have been drained in the city. The mileage of drain flushing has risen from nearly 40 to 42 miles and the number of special flushing cocks from 60 to 93.

The whole of the sullage is run on to a sandy island opposite the fort and used for irrigating a sullage farm which is growing very promising crops of tobacco plants, and it is hoped in time to get sufficient receipts from this sullage farm to more than cover its cost. It is an excellent way to get rid of the sullage at little or no cost to the municipality and avoids discharging a large quantity of impurities into the river especially at the bathing ghats.

4. *Allahabad*.—The pumping plant has worked well throughout the year. Four new boilers, ordered last year, have been received and fixed in their proper places. The surface condensers have been completed and are now in use. The stock of spare parts is carefully maintained.

There is an increase of 137 million gallons of water over last year, which is due to there being a "kumbh" this year and to a general increase in consumption. The number of house connections increased by 108 over last year and is now 2,169. The income from water rate and other receipts comes to Rs. 1,21,544 or more than double the maintenance charges which are Rs. 56,879.

The Alfred Park water supply is working satisfactorily and giving the full maximum supply asked for, but more is now required.

The total length of drains constructed during the year was 5,228 feet, the cost of which amounted to Rs. 1,875. A large scheme for the proper drainage of

the city is under preparation and in this scheme it is also contemplated changing the existing old and worn out latrines and where possible making them septic latrines in connection with the new drainage scheme.

5. *Benares* --The pumping plant at both stations has worked very satisfactorily. Two accidents occurred at the unfiltered station. One on 3rd September 1905, to the bolts of connecting rod and the other on 29th March 1906, to the knee girder of A, B and C, pumps; but both were put right very smartly and there was no stoppage of water. The broken girder has been repaired and the pumps are now working satisfactorily and two spare girders are ordered.

The consumption of filtered water during the year under report was 1,393 million gallons against 1,270 of last year. The maintenance charges amount to Rs. 79,770 which gives an average cost of 91 anna for 1,000 gallons of filtered water.

The income of water is very small as compared with other water works, but the total receipts are in excess of the maintenance charges by Rs. 18,030. There is an increase of 267 house connections over last year, the total number coming to 5,829.

The settling tanks Nos. 1 and 3 have been cleaned of silt; renewals of filters Nos. 1, 2 and 3 were completed, and that of No. 4 is in progress. Both clear water reservoirs were cleaned in March 1905.

The total expenditure on the sewerage works during the year amounts to Rs. 53,266 and the total expenditure from the commencement of the works up to end of March 1906, is Rs. 13,16,958; that is, there has been an excess of Rs. 16,993 over the total estimate of Rs. 13 lakhs. But there are materials at site of the approximate value of Rs. 19,885. So there is still a balance of Rs. 2,927 available. The system of sewerage works of Benares is the best in these Provinces. The total length of branch sewers this year, in addition to the main sewer, is 10,515 feet. The municipality has greatly benefited by carrying out these works departmentally.

The Chowka Ghat latrines with septic tank, the Piddian distributor, the Narkatia Pail depôts and the continuous filter, have been completed during the year under report.

The Dibdin system of purification of sullage is working satisfactorily at Assi Ghat. The effluent is of a good standard of purification.

The total quantity of 21,150 cubic feet of lime manufactured departmentally costs Rs. 11-5-0 per 100 cubic feet, against Rs. 22-8-0 in the market.

A detailed estimate for the completion of all sanitary works at Benares has been prepared and will shortly be submitted for sanction.

6. *Cawnpore*.--The pumping machinery has worked satisfactorily during the year. The new air balance gear to replace the steam balance has been put in to one of the engines and is working very satisfactorily and is a great improvement on the old arrangement. The other engine will be altered in the same way as soon as funds are available for the purpose.

The construction of a new settling tank is contemplated. The new seventh filter was completed in May 1905, and a venturi meter has been fixed to it for ascertaining the rate of filtration and an automatic indicator for reading the head on the filters. The meter is a great improvement on the old system of guessing at the filtration rate by the number of turns open of the valves. The result of six months' working with the venturi rate of filtration meter constructed by Messrs. Kent and Co. from my designs shows that the filter using it had from 32.4 to 77 per cent. fewer microbes per c. c. than the other six filters on the average of six months' working.

The new sand washer has been constructed. The house connections have increased by 197 over last year and are now 1,269.

During the year 1,125 feet of 6" and 756 feet of 4" and 693 feet of 3" additional water mains have been laid.

The total consumption of water is about 158 million gallons more than last year and the maintenance charges amount to Rs. 89,983 or Rs. 13,150 more than last year. This great increase is attributable to the necessity of making channels along the bed of the river from the pumping station to the main river which left

the station for a distance of 8,600 feet and to the maintenance of these channels which necessitated the constant employment of large gangs. The supply has not yet been extended to cantonment, and water rate has not been enforced in Cawnpore.

The latrines and pail depôts have worked satisfactorily throughout the year and no trouble with them has arisen. Additional branch sewers to several mills and factories have been constructed and the low level sewer engines and pumps have worked well during the year.

7. *Lucknow*.—The pumping machinery has worked well throughout the year. Settling tank No. 3 was suit cleaned and other tanks and filters have been kept in good order; 5,615 feet of 3" main pipe and 290 feet of 1½" pipe were laid down in city and civil lines.

The total quantity of filtered water pumped is 673 million gallons or about 89 million gallons more than last year. The total receipts from all sources amount to Rs. 73,937, which shows a balance of revenue over maintenance expenditure of Rs. 14,987.

La Place Irrigation Scheme.—A small pumping plant with distribution pipes for the irrigation of La Place Park was installed at a cost of about Rs. 31,000. The oil engine first supplied by the contractor failed to give the guaranteed amount and is being replaced by a more powerful engine at the contractor's expense. It is anticipated that this engine will be at work during May. In the meantime the supply is being kept up partly by the engine first supplied and the balance from the water works.

8. *Meerut*.—The Meerut water works continue to give the best quality of water in the Provinces. The average number of microbes per c. c. out of 268 samples works out to only 276 and out of these 268 samples 42 were sterile and 247 had two or less microbes per c. c.

The consumption of water is still very low, but has risen from 4.29 gallons per head per day to 4.84, an increase of nearly 13 per cent. All machinery is maintained in good order.

The supply of water to the cantonment has risen considerably. The daily averages being 1,62,385 gallons in 1904-05 and 2,39,023 gallons in 1905-06, an increase of 41.6 per cent.

The working charges were Rs. 22,579 and receipts from sale of water amounted to Rs. 32,647, showing a credit balance of Rs. 10,068.

Meerut water works has one of my rate of filtration meters on one filter and that filter shows the following percentages better results over the other three, viz., 20 per cent., 30.4 per cent., and 62 per cent. The average number of microbes per c. c. from the filter with the meter was only 1.46 while the average of the other three filters was 3.24 per c. c.

9. *Mussoorie*.—The large scheme for extending the water works and electric lighting to Mussoorie and Landour is in progress. Messrs. Bruce Peebles and Co. of Edinburgh's tender for supplying the machinery for the above scheme and Messrs. Simpson and Co.'s tender for piping have been accepted.

The maintenance charges for water works amount to Rs. 18,706 or Rs. 275 less than last year and the consumption of water has increased by 2,79,401 gallons. This is very satisfactory.

10. *Naini Tal*.—The pumping machinery is in good order and has worked well throughout the year. Two headers cracked in boiler No. 1 and the other in boiler No. 2; but they were replaced by new ones and did not interfere with the working of the boilers. The monsoon was not good, so the pumps had to work all through the season.

The maintenance charges amount to Rs. 35,886 or about Rs. 10,874 more than last year. This increase is chiefly due to the purchase of 150 tons of extra coal for Rs. 4,800 and some machinery for Rs. 2,810, and to the consumption of 54,34,788 gallons of more water than last year, costing Rs. 2,174. A large and increasing quantity of water is being stolen from the public tanks for such non-domestic purposes as irrigation of garden and for building. The following are the quantities pumped by the high lift engines during the last four years.

Years.	...	Quantity of water.	
1902-03	...	12,239,002	Gallons.
1903-04	...	17,990,002	"
1904-05	...	19,039,140	"
1905-06	...	22,281,987	"

The water has to be pumped up 1,350 feet and the cost of coal at Naini Tal is about Rs. 33 a ton. I calculate that the loss to the municipality from water taken for non-domestic purposes from public tanks to be not less than Rs. 6,000 a year.

Drainage Works.

Dehra Dun.—The construction of the surface drains of the town is finished. The military authorities have abandoned their intention of locating the mule batteries at Dehra-Rajpur; therefore the project for extending the water supply has been very much reduced and modified.

Deoband.—The work on construction of the drains is in progress.

Chandausi.—The construction of the drainage works is well and economically carried on by Mr. A. K. Nandi, my assistant. This work should be completed during this year (1906-07).

Patchgarh. The construction of the drains is in progress and about half the work completed; it is being well and economically done.

Pyzawal.—The construction of the drains is now being carried on under Mr. Lane Brown's supervision. Full detailed estimates are under preparation. Lime burning and grinding plant have been erected and this work will be rapidly pushed on after the rains.

Lucknow.—The drainage work of Lucknow has been pushed on very rapidly since Mr. Hewlett, the Resident Engineer, arrived in October last. In all 829 acres have been completely drained and paved, and in addition to this 29,941 feet of storm water underground sewers have been completed. This will completely do away with the serious flooding which this area has previously been subject to every rains. Owing to heavy rain early in June the flood water broke into Maulviganj storm water sewer when under construction bringing down and breaking a 15" water works main and threatening a serious collapse of the houses lining the excavated portions. But, thanks to the promptitude of Mr. Robertson, the Water Works Superintendent, and the energy and resource of Mr. Lane Brown, the damage done was slight and confined to two or three houses and was quite insignificant as compared with the seriousness of the occurrence.

The following shows the progress for the year :—

Main drains	...	...	...	15,189 linear feet.
Underground storm sewers	...	...	...	29,941 " "
Surface drains	...	...	...	121,096 " "
Kerbing and channelling	...	...	...	62,021 " "
				<hr/>
				231,217 " "
				<hr/>

or nearly 44 miles of drains. In addition to this brick flooring on concrete has been laid in the narrow streets as follows :—

Maulviganj	...	...	...	75,200 square feet.
Patanaula	...	...	...	50,122 " "
				<hr/>
				125,331
				<hr/>

Taking the average width of the lanes at 4 feet this means 6 miles of streets paved.

Stone paving had reluctantly to be abandoned on account of its cost and the large amount of lanes in which paving was an urgent sanitary necessity. To purify the sullage seven septic tanks, one continuous filter fed by a Fiddian distributor and three sets of double contact filters have been erected and another continuous filter with Fiddian distributor is under construction. These will completely purify the sullage of Maulviganj and Patanaula. Those completed are giving excellent results and will still further improve as the filters become more ripe.

The surveys, drawings and estimate for the complete drainage scheme of Lucknow are well in hand, and it is expected the estimate will be submitted for sanction in July.

The materials for the construction of a septic latrine on an improved Benares pattern are at site and the latrine will be erected as soon as funds are allotted. Should this turn out as successful as I hope, it will be the beginning of a far-reaching sanitary improvement in these Provinces. 229,527 cubic feet of lime were manufactured at the drainage works kilns. The local price of steam disintegrated lime was Rs. 25 per 100 cubic feet. As soon as we started our kilns we manufactured lime at Rs. 15 and quickly got the price down to Rs. 8-12-0 per 100 cubic feet. I calculate the saving effected by burning lime departmentally to be not less than Rs. 30,000 for the year.

Cement invert blocks for drains which showed a considerable saving over stone when they cost 3 annas a foot are now reduced down to 1 anna and 6 pies. Gully trap blocks are manufactured at our kilns at half the cost of imported gully traps. The expenditure of the year on drainage was Rs. 2,83,623-13-10 and work to the extent of Rs. 1,35,000 in addition to this has been completed and will be paid for out of the balance at the credit of the municipality pending sanction of a further loan. Great credit is due to Mr. Lane Brown and Mr. Hewlett for the excellent, economical and rapid work that has been done in Lucknow.

Mirzapur.—The construction of the drainage works is nearing completion. The works have been carried out with the greatest economy. I should like specially to bring to the notice of Government the excellent work of Mr. O'Brien, the Municipal Engineer.

A scheme for water works in this town is contemplated.

The projects for the drainage of Budann, Hathras and Moradabad are nearing completion and those of Azaungarh, Pirozabad, Khurja and Huldwani have been completed.

The surveys are in progress in Hapur, Etawah, Saharanpur and Gorakhpur and about to be undertaken in Amroha and Sambhal.

For want of sufficient staff under the Sanitary Engineer, the preparation of schemes for Muttra and Brindaban, Jaunpur and Ghazipur, Panchauna and Bahrich, has been given over to Mr. Lane Brown, who will prepare them under my supervision. Government has approved of the appointment of two Deputy Sanitary Engineers, but the sanction of the Government of India is awaited. As soon as these officers are appointed, I hope to see a much better progress in sanitary works in these Provinces.

I place on record with much regret the untimely death of the late Babu Roop Kain, who had done exceptionally excellent work to this Department, and in whom I have lost an experienced and able subordinate.

Inspection of Boilers.—During the year under report 673 boilers and 640 prime movers were inspected; but still there are boilers and prime movers which are not brought to notice because the owners try to evade the Act. The income and expenditure of this Department for the year under report is as follows :—

			Rs.
Total income for 1905-06	...	...	25,611
Total expenditure for 1905-06	...	...	17,724
			<hr/> 7,887 <hr/>

There is thus a balance of about Rs. 8,000, which added to former balances makes the total amount at credit Rs. 19,050. After another year's working, should there be a considerable credit balance I shall propose a reduction of the fees. In the meantime part of this credit balance might very usefully be employed in purchasing models for the use of the Board of Examining Engineers for granting certificates under the Boiler Act. There is still much room for improvement in the Boiler Act, and when the revised Act, which is under consideration, is passed, most of the friction which is now apparent, will, I hope, disappear.

General.—Very considerable progress has been made in sanitation during the year.

Important experiments are being carried out with a view to ascertaining the time which should be allowed in India for septic treatment of (a) domestic sewage, (b) sullage, and also the best means of completing their purification. The

results so far are very encouraging. I hope soon to be able to introduce into Lucknow and other towns in those sites where the levels are suitable, a large number of septic latrines connected with bacteria beds, the effluent from which will be odourless non-putrescent and practically colourless and which can be safely discharged into the surface drains. This will cause a considerable saving in conservancy, and on account of the cleanliness and absence of smell it will be a great boon to those who use public latrines.

Experiments are being made to ascertain the best rate of sand filtration for water supplies and also the time and least amount of water which should be run to waste before bringing a filter which has been scraped or renewed into use. Both are very important points, and when known will greatly improve the uniformity of the general excellence of the water works supplies of these Provinces.

ALLAHABAD :
The 15th May 1906. }

D. W. AIKMAN,
*Superintending Engineer,
Sanitary Engineer to Government,
United Provinces.*

APPENDIX.

APPENDIX

UNITED PROVINCES

Statement of Operations

	Agia	Allahabad.	Benares
<i>Population.</i>			
By Census of 1901 in Municipality...	165,981	159,515	201,373
Ditto Cantonments ..	22,011	12,187	1,958
Total ...	188,022	172,032	209,331
<i>Cost of Works.</i>			
Initial capital cost ... Rs.	11,70,761	16,21,061	25,61,881
Cost of extensions and improvements to end of previous year. „	2,78,753	91,499	1,53,450
Ditto ditto during year .. „	47,162	11,614	1,133
Total cost of works ... „	14,96,976	17,57,174	27,16,464
<i>Consumption of filtered water.</i>			
During year, including Cantonments ... Gallons.	913,276,961	795,378,689	1,393,378,108
Daily average, ditto ... „	2,584,320	2,179,119	3,811,872
Maximum daily average in any one month „	3,085,683	3,006,471	4,583,518
Daily average for Cantonments alone ... „	315,896	227,288	1,589
Average number of hours filtered water pumped daily.	8-63	12-55	9-9
<i>Annual Charges and Receipts.</i>			
Maintenance charges ... Rs.	87,920	56,879	79,770
Total charges with interest and payment of loan. „	175,899	100,102	161,614
<i>Income from Water Works.</i>			
Water rate recovered during year ... Rs.	62,183	87,950	91,732
Sales of water and other receipts ... „	31,424	33,594	6,068
Total income ... „	96,607	121,544	97,800
<i>Number of house connections at end of year.</i>			
For purely domestic purposes ...	1,118	2,022	5,747
For other purposes ...	101	147	82
Total ...	1,219	2,169	5,829
Number of connections with Meters ...	90	209	82

No. I.

WATER WORKS.

during the year 1905-1906.

Cawnpore	Lucknow.	Meerut	Mussoorie.	Naini Tal.
172,674	240,568	78,740	14,689	14,220
24,496	23,407	39,389	3,711	944
197,170	263,975	118,129	18,400	15,164
14,41,353	15,15,736	751,710	73,045	247,000
182,016	128,866	...	10,930	294,405
110,332	12,149	...	31,552	471
17,33,701	16,56,751	751,710	115,536	541,873
1,113,042,087	673,688,094	209,003,545	*7,980,186	29,238,349
3,049,430	1,845,720	572,612	39,902	80,105
3,871,557	23,56,561	10,23,311	38,141	17,916
...	2,50,894	2,39,023	...	1,791
16.91	9.42	13.15	17.01	9.75
89,983	58,950	32,647	18,706	35,886
143,973	1,34,896	97,375	21,514	70,407
...	26,576	...	...	25,011
38,473	47,361	†32,647	...	4,045
38,473	73,937	32,647	...	29,056
1,031	730	166	...	83
238	55	2	...	3
1,269	785	168	...	86
209	59	12	...	82

* Excluding Cantonment.

† Including Rs. 30,000 from Cantonment.

TENTH ANNUAL REPORT
OF THE
SANITARY ENGINEER

TO
GOVERNMENT, UNITED PROVINCES.

FOR THE YEAR ENDING 31st MARCH 1905.



ALLAHABAD:
Printed at the Government Press, United Provinces
1905.

Tenth Annual Report of the Sanitary Engineer to Government, United Provinces, for the year ending 31st March 1905.

THE post of the Sanitary Engineer was held throughout the year by Mr. D. W. Aikman, Superintending Engineer, Public Works Department.

2. During the year under report, the Sanitary Engineer visited, besides the eight water works stations, Bareilly, Budaun, Dehra Dūn, Brindaban, Amroha, Hathras, Rae Bareilly, Puzabad, Mirzapur, Najibabad, Moradabad, Orai, Fatehgarh, Muttra, Etāwah, Sitapur, and Rajpur for the purpose of inspecting work, and advising municipalities on sanitary schemes.

3. *Agra*.—The pumping plant has worked well throughout the year, and reserve spare parts of the value of Rs. 8,043 have been stocked to be available at any time. The spare parts are to be treated as an imprest and to be made good from time to time as they are indented on.

The extension of the Clear Water Reservoir recommended by me last year has been taken in hand as well as the new fifth filter. A fifth settling tank should be undertaken when funds are available; this is not of pressing urgency. When these works are completed the water works installation will suffice for many years to come. There is a steady increase in the supply of water every year owing to much water being used for non-domestic purposes. Care should be taken to regulate this so that the engines are not overtaxed and that an adequate supply of water for domestic purposes in the city and cantonments is maintained.

There was a burst on the 28 inches main owing to the temperature having gone down to the freezing point, but the supply was not interrupted.

The income from water rate, sale of water and other receipts is Rs. 1,43,189 or Rs. 39,664 more than last year and shows a balance of Rs. 72,712 over maintenance charges. This income includes an item of Rs. 50,000 paid by the Military authorities as the first instalment of their share in the Municipal Water Works. I consider that this sum of Rs. 50,000 and all further instalments from the Military authorities should be utilized for payment of the Government loan on water works.

The Secretary-Engineer shows a saving of Rs. 5,745 worth of coal this year, but the cost of 1,000 gallons of filtered water works out to 1.55 annas against 1.47 annas of last year. There is, thanks to this instalment of Rs. 50,000, a great falling off in the net charges, it being .23 annas against .98 annas of last year. There is an increase of 159 house connections over last year. But excluding this extraordinary receipt the results are not so good as last year owing partly to the purchase of spare parts from revenue and a falling off of Rs. 10,335 in receipts when the Rs. 50,000 is excluded.

The saving in coal amounting to Rs. 5,745, is very satisfactory, and is due to Mr. Rogers' patent mica composition and his careful management. He has also made considerable savings on the drainage works and in the manufacture of lime.

The fort drain taken up last year is finished and the intercepting sewer is well advanced and is expected to be finished before the rains. When completed, the sanitation of the city will be greatly improved. About 30 miles of drain flushing are carried out.

4. *Allahabad*.—The pumping machinery has worked satisfactorily throughout the year. Four new boilers—2 for each station, have been ordered and a sufficient supply of spare parts has been stocked.

There is an increase of 68 million gallons of water over last year, but notwithstanding this the maintenance charges have decreased by Rs. 2,216. This is satisfactory. The cost of coal per 1,000 gallons is 1.35 annas against 1.57 annas of last year. The income from water rate and other receipts is Rs. 1,12,279 or more than double the maintenance charges which are Rs. 55,586.

A scheme, amounting to Rs. 52,430, for supplying water to the Alfred Park, Muir Central College, Training College, Government House and Secretaries' quarters was carried out by Mr. Wasdell, the Water Works Engineer, for which Government granted him an honorarium of Rs. 500.

5. *Benares*.—The pumping plant at both stations has worked very satisfactorily. There were some bursts and leaks, but none of them was large enough to deserve mention. A sufficient supply of spare parts is in stock.

The consumption of filtered water during the year under report was 1,270 millions of gallons against 1,220 of last year. The maintenance charges amount to Rs. 72,795, which give an average cost of .92 annas for 1,000 gallons of filtered water. The number of house connections increased by 334 over last year and is now 5,562.

The income from sale of water is very small here compared with Agra and Allahabad, Cawnpore, Lucknow and Meerut, but the total receipts are in excess of the maintenance charges by Rs. 18,223. Still Benares is the cheapest of all water works in these Provinces. Great credit is due to Mr. Cash, the Superintendent, for his careful and economical management.

Settling tanks Nos. 1 and 2 have been silt cleaned and filters Nos. 1 and 6 were renewed and Clear Water Reservoir was cleaned in March.

The total expenditure on the sewerage works during the year amounts to Rs. 98,965 and the total expenditure from the commencement of the works up to end of March 1905, is Rs. 12,65,210 out of the total estimate of 13 lakhs. There is a balance of Rs. 34,790 available for this purpose. Benares has got the best system of sewerage works in these Provinces. The main system of sewers is now approaching completion. To take full advantage of these works the municipality must gradually extend branch sewers as funds admit. The construction of storm over-flows and intercepting sewers has entirely stopped the discharge of sewage from the old Dassasumudh sewer into the Ganges, and the pumping plant has been disposed of. All these works are carried out departmentally to the great benefit of the municipality. A total quantity of 146,208 cubic feet of lime was manufactured costing about Rs. 11 per 100 cft. against Rs. 20 in the market—a saving of Rs. 13,158 in this item alone. This is very satisfactory.

The Dibdin system of purification of water is working satisfactorily at Assi Ghat. The effluent is of a good standard of purification.

6. *Cawnpore*.—The pumping plant has been well looked after and has worked well throughout the year. The supply of spare parts is sufficient.

Settling tank No. 1 and the Water Tower have been thoroughly cleaned and filters Nos. 1, 2, 4 and 6 have been renewed with white sand.

During the year 5,607 feet of 4" and 2,097 feet of 3" water mains were laid along the road to Raipurwa, and to the dwellings of Cooper Allen's workmen.

The total consumption of water is about 50 million gallons more than last year and the maintenance charges amount to Rs. 76,833 or half as much again as last year. This great increase is attributable to clearing settling tanks &c., and repairing and purchasing machinery. The supply has not yet been extended to Cantonments and water rate has not been enforced in Cawnpore. Hence the receipts on account of sale of water &c. fall far short of the maintenance expenses, which work out to one anna three pies per 1,000 gallons of filtered water.

Owing to the steady increase in the demand for water for flushing purposes in connection with the sewerage scheme, it has been found necessary to double the 20" rising main from the river pumping station to the filtering station and constructing a seventh filter. The workshop at Benajhaber is being extended to meet increased work.

The construction of branch sewers which was commenced last year is completed and twenty-eight latrines with pail depôts are now open for use. Extensions of the sewers to the model villages erected by some of the mills have been sanctioned, and are being carried out.

7. *Lucknow*.—The pumping machinery has been very well cared for and has worked most satisfactorily throughout the year. All repairs to machinery are executed in the workshop at Aish Bagh.

The total quantity of filtered water pumped is 584 million gallons or about 33 million gallons more than last year.

The total working charges amount to Rs. 53,430, which are below the budget allotment by Rs. 8,412. Thus the actual cost of filtered water per 1,000 gallons works out to one anna and five pies, which is a little less than at Agra and a little more than at Cawnpore.

The total income from water rate and sale of water comes to Rs. 82,683, which is again a record. The greatest increase is in the receipts from sale of water which alone amount to about Rs. 50,000 or more than half as much again as last year. The new Water Works Inspector, Mr. R. K. Sarcar, has done much towards stopping the wastage of water, and Mr. Robertson, the Superintendent, speaks highly of him. The net cost of water at Lucknow after including interest and sinking fund, is only 1·005 annas per 1,000 gallons. This is most satisfactory and reflects great credit on Mr. Robertson, the Superintendent.

The work on the surface drainage of Lucknow has not been so satisfactory as it ought to have been. This is due to Mr. Bell, the Municipal Engineer, having died shortly after his appointment and his successor having resigned the post. Now Mr. H. Lane Brown, the Supervising Engineer, is making all possible endeavours to push on the work.

An installation to irrigate the La Place grounds at Lucknow is in the course of completion. The work is being carried out by contractors, except the pipe laying which is being done very economically by Mr. Robertson, the Water Works Superintendent.

8. *Meerut*.—There is an increase of about Rs. 10,000 in the maintenance charges over last year. This is due to the purchase of spare parts which are now adequately stocked. The turbines are in good working order. There is a very small increase in the consumption of filtered water over last year. The receipts from sale of water exceed the working charges by Rs. 1,260. There is no water rate at Meerut.

Filter No. 2 was cleaned and 30,000 cubic feet of sand has been stocked.

A 3" sluice valve to 15" main and a venturi meter to filter No. 1 have been fixed at my suggestion, the former to meet emergencies in cases of breakdown and the latter to measure accurately the rate of filtration. The adaption of the venturi meter to this duty is a suggestion of my own and has proved so successful at Meerut that I propose gradually extending it to all the filters of the Municipal Water Works in the provinces as funds admit.

With these meters in use complete control of the rate of filtration and hence of the quality of the water will then be possible.

9. *Mussoorie*.—Mr. P. Billingham having resigned the appointment, Mr. C. H. Shanahan has been appointed to the vacancy. The large scheme for extending the water works and electric lighting to Mussoorie and Landour has been sanctioned by Government, and I am in correspondence with the several railways concerned regarding the carriage of materials to Dehra Dún. There is great delay in calling for tenders, due, I believe, to one of the members of the Board suggesting that the tenders may have already been placed—a mischievous statement if made without ground and a serious statement if made with good ground. In either case, in my opinion, it is a statement that should be taken notice of.

The maintenance charges show an increase of Rs. 6,000 over last year without any increase in the consumption of water. The increase cannot be accounted for from the information received unless the excess has been spent on purchasing spare parts, or in dearer fuel. I have called for further details.

10. *Naini Tal*.—The pumping plant is in good order and has worked well throughout the year. The consumption of water was less this year owing to more rains and in consequence there was a saving of Rs. 1,300 in the working charges. The quarters for the Water Works staff have been completed. The plans for constructing latrines and urinals in the Upper Bazar have been sanctioned.

Drainage Works.

11. *Dehra Dūn*.—The construction of the surface drains of the town is well advanced. Plans and estimate for increasing the supply of water to Dehra and also supplying water to the Mule Batteries at Dehra-Rajpur are under preparation.

12. *Deoband*.—The work on construction of the drains is in progress.

13. *Chandausi*.—The plans and estimate having received the sanction of Government, the construction of the drainage works is in progress.

14. *Farrukhabad*.—The construction of the enlarged drainage scheme has been completed and construction of the drains of Fatehgarh is about to start.

15. *Lucknow*.—Out of the big surface drainage scheme for which the India Government has given a grant of 3 lakhs and this Government one lakh, Nadi is completed and Maulviganj and Kandhari Bazar drains are approaching completion.

16. Projects for the drainage of Azamgarh, Gorakhpur, Ferozabad and Saharanpur are nearing completion. Owing to the dilatoriness of the Municipal Board, the construction of Fyzabad drainage has not yet started. Surveys are in progress in Moradabad, Khurja and Haldwani, and about to be undertaken in Muttra, Brindaban, Ujhani and Ilapur. The preparation of the revised project for Hathras will be taken up as soon as a man is available and funds for the purpose are allotted.

17. *Inspection of Boilers*.—An Inspector to inspect the boilers in the town of Cawnpore was appointed in October 1901, but the work of inspection was started in the beginning of 1902. The Steam Boilers and Prime Movers Act was gradually extended to the whole province by 1904. An assistant Boiler Inspector was appointed in 1903 and now a second assistant Inspector has been sanctioned by Government because the work of inspection could not be managed by two Inspectors. Every endeavour has been made in consultation with the Upper India Chamber of Commerce to fix the dates of inspections so as to interfere least with commercial undertakings and to meet the wishes of owners as far as practicable.

There have been several attempts at evasions of the Act and these have been brought to notice of the Magistrates of the districts in which they occurred. But until the Act is amended and penalty clauses inserted for infringements of the Act it is not possible to make it work perfectly.

18. *Sanitary Engineer's establishment*.—The work of the Sanitary Engineer has increased at least fourfold in the last few years and is now more than can be efficiently carried out by one man. There are many drainage projects in the smaller municipalities under preparation and construction; these require frequent inspections for their proper preparation and completion, but although the Sanitary Engineer travels some 3,000 miles a month during the touring seasons, he is unable to visit these places more than once or twice a year. The Assistant to Sanitary Engineer is practically always lent to municipalities for the carrying out of projects. I suggest therefore, to start with, that two or at least one Deputy Sanitary Engineer be appointed on a salary of Rs. 500—50—700 as, I understand, is being done in Bengal.

NAINI TAL: }
The 8th May 1905. }

D. W. AIKMAN,
Superintending Engineer,
Sanitary Engineer to Government,
United Provinces.

APPENDIX.

APPEN
UNITED PROVINCES
Statement of Operations

		Agra.	Allahabad	Benares.
<i>Population.</i>				
By Census of 1901 in Municipality	...	165,981	159,545	204,373
Ditto Cantonments	...	22,041	12,487	4,958
Total	...	188,022	172,032	209,331
<i>Cost of Works.</i>				
Initial capital cost ...	Rs.	11,70,761	16,24,061	25,61,881
Cost of extensions and improvements to end of previous year ...	"	2,74,941	81,336	1,41,064
Cost of extensions and improvements during year ...	"	3,811	10,163	12,386
Total, Cost of Works	"	14,49,513	17,15,560	27,15,331
<i>Consumption of filtered water.</i>				
During year including Cantonments ...	Gallons.	724,510,310	657,510,942	1,270,301,208
Daily average ditto ...	"	1,984,137	1,801,399	3,480,277
Maximum daily average in any one month ...	"	2,954,947	2,564,095	4,028,812
Daily average for Cantonments alone ...	"	283,415	180,232	1,642
Average number of hours filtered water pumped daily ...	"	7.89	11.37	9.5
<i>Annual Charges and Receipts.</i>				
Maintenance charges ...	Rs.	70,477	55,586	72,795
Total charges with interest and payment of loan ...	"	1,53,557	1,55,688	1,57,639
<i>Income from Water Works.</i>				
Water rate recovered during year ...	Rs.	60,755	82,919	83,910
Sales of water and other receipts ...	"	82,434	29,360	7,108
Total, Income	"	1,43,189	1,12,279	91,018
<i>Number of house connections at end of year.</i>				
For purely domestic purposes ...	...	1,016	1,926	5,466
For other purposes ...	...	98	135	96
Total	...	1,114	2,061	5,562
Number of connections with meters	...	84	188	96

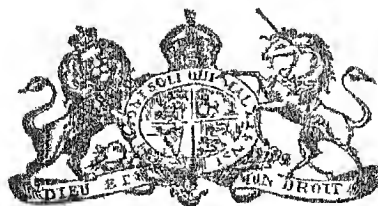
DIX No I
WATER WORKS
during the year 1904-5.

Cawnpore	Lucknow	Meerut.	Mussoorie	Naini Tal
172,674	240,568	78,740	14,689	11,220
21,496	23,407	39,389	3,711	944
197,170	263,975	118,129	18,400	15,164
11,11,353	15,15,736	7,51,710	73,015	2,17,000
1,68,187	1,14,236	..	...	2,91,739
13,829	11,630	.	10,939	2,666
16,23,369	16,44,602	7,51,710	83,981	5,41,405
954,597,071	583,895,420	191,559,636	*7,701,085	23,803,562
2,616,331	1,599,713	521,848	...	65,215
3,500,000	1,961,590	806,412	32,129	140,191
...	327,993	162,385	...	1,844
14.96	9.2	12.75	19.7	9.62
76,833	53,430	30,936	18,981	25,012
1,30,823	1,29,376	52,513	21,789	11,507
...	27,961	...	..	24,431
34,941	51,719	† 32,197	...	3,296
34,941	82,683	.	...	27,727
871	...	142	...	71
198	656	2	...	3
1,072	656	144	..	74
169	47	9	...	70

* Excluding cantonments.

† Including Rs. 30,000 from cantonment

NINTH ANNUAL REPORT
OF THE
SANITARY ENGINEER
TO
GOVERNMENT, UNITED PROVINCES.
FOR THE YEAR ENDING 31ST MARCH 1904.



ALLAHABAD:
Printed at the United Provinces Government Press.
1904.

NINTH ANNUAL REPORT
OF THE
SANITARY ENGINEER
TO
GOVERNMENT, UNITED PROVINCES,
FOR THE YEAR ENDING 31st MARCH 1904.



ALLAHABAD:
Printed at the United Provinces Government Press,
1904.

Ninth Annual Report of the Sanitary Engineer to Government, United Provinces, for the year ending 31st March, 1904.

THE post of Sanitary Engineer to Government was held throughout the year by Mr. D. W. Aikman, Superintending Engineer, Public Works Department.

2. During the year under report the Sanitary Engineer visited, besides the eight water-works stations, Aligarh, Azamgarh, Bareilly, Dehra Dún, Fatehgarh, Fatehpur, Firozabad, Fyzabad, Gorakhpur, Hathras, Jhansi, Kalpi, Khurja, Muzaffarnagar, Orai, Pilibhit and Saharanpur for the purpose of inspecting works and advising municipalities on sanitary schemes.

3. *Agra*.—The pumping plant has worked well throughout the year and an extra auxiliary Donkey Pump has been placed in reserve to be available in case of accidents. A full complement of spare parts has been stocked as ordered by the Government.

There is a steady increase in the supply of municipal water as is evidenced by about 26 millions of gallons, or 4 per cent., more being consumed over last year. The extension of the Clear Water Reservoir, which was to be done in October last, has not been taken in hand yet. It should be extended next winter.

The income from water rate and other receipts is Rs. 1,03,525, thus showing an increase of Rs. 12,223 over last year's figures and a balance of Rs. 40,823 over maintenance charges. The economy effected in the expenditure and the raising of income from sale of water, &c., are due to Mr. Rogers for his successful management all round.

The great saving in coal is due to the use of his patented Mica composition.

There was again no burst on the 28" rising main this year. The number of house connections rose by 105 over last year. There is an appreciable decrease in the cost per 1,000 gallons of filtered water. The following is a comparative statement for the last three years :—

1901-02.	1902-03.	1903-04.
2.24 annas.	1.33 annas	.98 annas.

The workshop has been turning out very good and economical work. It turned out, amongst other work, a 12 cwt. gun metal casting at a price Rs. 2,000 below that quoted at presidency towns.

An arrangement has been come to with the military authorities to utilize their raised reservoir in case of any serious fire in the coming summer and a fire engine has been provided close to Cotton Presses.

The diversion of the fort drain has been put in hand and the intercepting sewer, for which plans and estimates have already been approved by the Sanitary Board, will be commenced after the monsoon. The sullage of the city was lifted by hand labour at a cost of Rs. 3,300. This will be saved after the intercepting sewer and fort drain are completed.

4. *Allahabad*.—The pumping plant and boilers are in good order and have worked well during the year. The grounds have been well kept. There is an increase this year of 24 million gallons in the consumption of filtered water as compared with last year during which it was less by about the same quantity on account of the very serious accident. Two new pump barrels, one from Jessop & Co., and the other from Simpson & Co., were ordered and used during the year. The latter, which was used the whole time the river was in flood, was found to have worn only about $\frac{1}{16}$ ".

The whole of the silt from No. 1 settling tank was removed. The cleaning of settling tank No. 3 has been commenced and is in progress.

The income from water rate, sale of water and other receipts, amounts to Rs. 1,06,678, and though a little less than last year, the percentage of balance over expenditure is very nearly maintained.

Mr. Wasdell, the Water Works Engineer, has very successfully managed the water-works and flushing of drains since he was put in exclusive charge of them last year.

5. *Benares*.—The pumping plant at both the stations has worked efficiently and well. Two accidents occurred at the river station : one on 23rd August 1903,

to the bottom bolts of connecting rod, and the other on 20th March 1904, to the teeth of spur pinion; but both were put right within reasonable time. The spare parts referred to last year have been received and fitted. The settling tanks and filters have been properly kept as also the buildings and grounds.

About 400 house connections were made during the year, making a total of 5,228, of which 85 are with meters. The consumption of filtered water during the year was 1,220 millions of gallons against 1,150 of the previous year, showing an excess of 70 millions. The new Water-Works Inspector, Mr. J. W. Broadey, has done much towards minimising the wastage of water and the results will be more favourable next year.

The income from water rate, sale of water and other receipts, shows a balance of Rs. 19,174 over expenditure on account of maintenance charges, and the cost per 1,000 gallons of filtered water is .89 annas, which is the lowest of all the water-works in these Provinces. Mr. Cash, the Superintendent, has kept the works in a high state of efficiency. The supply has been extended to the Central and District Jails.

The total expenditure on the sewerage works during the year amounted to Rs. 95,609, or nearly double the amount spent in the previous year. The whole of the main and branch sewers have been systematically inspected and flushed. The pumping at Dassaswamedh station was stopped in July last on the sewer being connected with the new branch sewer and the engine has since been sold to the Lucknow Municipality.

The engine house has been dismantled and the materials will be utilized in building a slaughter house.

The Dibdin system has worked satisfactorily. Kankar lime has been manufactured departmentally and the total cost per 100 cubic feet of lime has worked out to Rs. 11 against Rs. 20 in the market—a very creditable economy.

Mr. Gerard E. Hull, the new Assistant Engineer who joined last August, is an experienced man and should prove of great value to the Municipality in the supervision of the large works under construction.

6. *Cawnpore*.—The pumping machinery has been regularly overhauled at both the stations and has worked well without a breakdown. A sufficient supply of spare parts has been stocked.

The new filter mentioned in my last annual report has been completed and settling tank No. 3 has been thoroughly cleaned. The Engine Drivers' quarters, as also a set of 10 rooms for the workmen at the filtering station were completed. During the year 8,800 feet of additional mains have been laid, the principal extensions being along the road to Nawábganj. The total consumption of filtered water exceeded last year's figures by 48 million gallons, and the amount realized by sale of water and other receipts was only a few rupees more than last year. Water rate has not yet been enforced in Cawnpore and the maintenance charges are therefore not covered by receipts. The cost per 1,000 gallons, however, works out to one anna two pies which is satisfactory. The military authorities are contemplating an extension of the supply to cantonments, but up to the present only the Government Harness Factory has been connected.

A very large quantity of water is being used in flushing the drains, latrines and pail depôts, and when the new sewerage works are completed, the demand for water will increase still further. This will soon necessitate the doubling of the rising main and increasing the unfiltered supply pumping installation.

The main intercepting sewer and the low level sewers have been completed. An installation of machinery for the pumping of sewage was completed in December last and since then it has been working. Several mills and factories have constructed, or are about to construct, latrines and pail depôts of their own connecting them with the sewerage system. Work on the construction of branch sewers and other subsidiary works is being carried out by contractors and good progress is being made in spite of scarcity of labour owing to plague. Out of a total length of 39,750 feet of sewers, about 22,000 feet have been completed.

7. *Lucknow*.—The pumping machinery has worked well throughout the year and all necessary repairs have been executed in the workshop at Aish Bágh. The quantity of water consumed shows an increase of 55 millions of gallons, or 10 per cent. over last year, and the working charges have accordingly increased by Rs. 7,669 owing to purchase of coal and machinery. But the receipts from water rate,

sale of water and other sources show a large increase, and there is thus a balance of Rs. 18,076 over expenditure on account of maintenance. The cost per 1,000 gallons is 1·4 annas, or a little above that in Cawnpore. The Superintendent with his subordinate staff deserves credit for successful management of the works.

The surface drainage of Lucknow is being pushed on with all possible despatch. Narhi drain is completed and work on Maulviganj is going on. Mr. H. Lane Brown, Resident Engineer, Benares, has been put in supervising charge of Lucknow drainage, and Mr. Bell has been appointed Municipal Engineer to work under his guidance.

8. *Meerut*.—These water-works have maintained their reputation as first class from every point of view. The turbines have worked satisfactorily and the 15" Venturi Meter gives every satisfaction.

The filters continue to give very good results and are kept in excellent condition. The consumption of filtered water has increased by 13 millions of gallons over last year and this year the figure is the highest since the water works were started. The income from sale of water has accordingly increased. If my suggestion of extending the pipe line to the Civil Lines were carried out, the receipts would be very considerably increased.

The spare parts ordered have not yet arrived. The sand washing platform has been enclosed at a cost of Rs. 2,900 and a quantity of 4,000 cubic feet of red sand has been stocked.

9. *Mussoorie*.—Mr. P. Billinghamurst has been appointed to work out the scheme for the improvement of Mussoorie Water-Works and electric lighting of Mussoorie and Landour.

The maintenance charges are a little higher than last year and there is an increase of 377,359 gallons of water accordingly.

Work on improving the condition of Landour Bazar is in progress and Rs. 12,373 has been spent.

10. *Naini Tal*.—The engines and boilers have worked well, and two new chimneys for the boilers at Lake Station have been made. A new connection from Ayarpatta reservoir to Bara Nadi has been made. There is an increase of 10,157,500 gallons of water over last year and this is due to the late breaking of the rains, in consequence of which there was a large demand for water, and the working charges have accordingly increased. There is a decrease of about 2 tons of coal per million gallons which is satisfactory; 13 new house connections were made during the year.

Plans and estimate amounting to Rs. 5,773 for constructing quarters for the water-works staff have been sanctioned and the construction of latrines and urinals in the Upper Bazar is under consideration.

11. *Aligarh*.—The construction of outfall drains for sullage of the town is completed.

12. *Dehra Dun*.—The construction of the surface drains of the town is in progress.

13. *Deoband*.—Construction work is about to start on the drains.

14. *Farrukhabad*.—The work of construction of the enlarged drainage scheme is approaching completion.

15. *Muzaffarnagar*.—The construction of the surface drainage of the town has been completed.

16. Projects for the drainage of Azamgarh, Gorakhpur, Saharanpur, Chandauli, Firozabad and Nagina are under preparation; those for Hathras and Fyzabad have been completed and work is about to start in the latter town.

NAINI TAL :
The 5th May 1904.

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D. W. AIKMAN,
Superintending Engineer,
Sanitary Engineer to Government,
United Provinces.

APPENDIX.

APPEN
UNITED PROVINCES
Statement of operations

		Agra.	Allahabad	Benares.
<i>Population.</i>				
By Census of 1901 in Municipality ...	...	165,981	1,59,545	204,373
Ditto ditto Cantonments ...	...	22,041	12,487	4,958
Total	...	188,022	172,032	209,331
<i>Cost of Works.</i>				
Initial capital cost ...	Rs.	11,70,761	16,24,061	25,61,881
Cost of extensions and improvements to end of previous year	,,	2,67,678	80,920	1,15,248
Ditto ditto during year	,,	7,263	416	25,816
Total cost of works ...	,,	14,45,702	17,05,397	27,02,945
<i>Consumption of filtered water.</i>				
During year, including Cantonments ...	Gallons	682,783,030	589,490,424	1,220,180,742
Daily average ditto ...	,,	1,865,527	1,610,629	3,333,827
Maximum daily average in any one month	,,	2,427,289	2,247,127	4,122,309
Daily average for Cantonments alone ...	,,	275,835	161,256	1,689
Average number of hours filtered water pumped daily.		7.8	10.34	8.75
<i>Annual Charges and Receipts.</i>				
Maintenance charges ...	Rs.	62,703	57,802	68,136
Total charges with interest and payment of loan	,,	1,45,342	1,57,904	1,52,980
<i>Income from Water-Works.</i>				
Water rate recovered during year ...	Rs.	67,772	83,945	83,111
Sales of water and other receipts ...	,,	35,754	22,730	4,199
Total income ...	,,	103,526	106,675	87,310
<i>Number of house connections at end of year.</i>				
For purely domestic purposes ...	...	854	1,788	5,143
For other purposes ...	...	101	131	85
Total	...	955	1,919	5,228
Number of connections with meters ...	...	80	131	85

DIX No. I.

WATER-WORKS.

during the year 1903-1904.

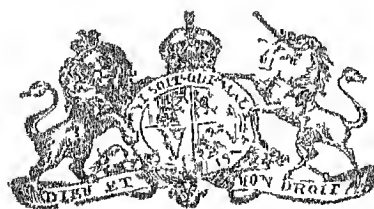
Cawnpore.	Lucknow.	Meerut.	Mussoorie	Naini Tál
172,674	240,649	78,740	14,689	14,220
24,496	23,400	39,389	3,711	744
197,170	264,049	118,129	18,400	15,164
14,41,353	15,15,736	7,51,710	64,186	2,47,000
1,35,640	95,111	...	8,858	2,88,663
32,547	19,125	...	...	...
16,09,540	16,29,972	7,51,710	73,014	5,35,663
905,316,688	5,51,075,062	186,381,883	7,877,174	32,874,735
2,473,542	1,505,669	510,635	39,385	87,405
3,288,333	1,868,757	778,674	46,481	173,005
...	270,366	201,976	...	1,455
14.88	8.7	12.58	18.2	12.5
68,031	50,345	21,192	12,840	26,344
1,22,021	1,26,291	64,728	15,648	23,014
...	25,939	*30,000	...	24,088
30,485	42,482	2,370	...	2,275
30,485	68,421	32,370	...	26,363
711	562	125	...	60
176	...	...	...	5
887	562	125	...	65
147	40	10	...	63

* Rs. 30,000 from Cantonments.

EIGHTH ANNUAL REPORT
OF THE
SANITARY ENGINEER

GOVERNMENT, UNITED PROVINCES.

FOR THE YEAR ENDING 31ST MARCH 1903.



ALLAHABAD:

Printed at the Government Press, United Provinces.

1903.

EIGHTH ANNUAL REPORT
OF THE
SANITARY ENGINEER

10

GOVERNMENT, UNITED PROVINCES,

FOR THE YEAR ENDING 31ST MARCH 1903.



ALLAHABAD:

Printed at the Government Press, United Provinces.

1903.

Eighth Annual Report of the Sanitary Engineer to Government, United Provinces for the year ending 31st March 1903.

=====

THE post of the Sanitary Engineer to Government was held throughout the year by Mr. D. W. Aikman, Superintending Engineer, Public Works Department.

2. Besides the eight Water-Works Stations, the Sanitary Engineer, during the year under report, visited Aligarh, Azamgarh, Badaun, Bareilly, Dehli Dún, Fatehgarh, Ferozabad, Fyzabad, Gonda, Haldwani, Hathras, Lakhimpur, Moradabad, Muzaffarnagar, Nagina and Pilibhit, for the purpose of inspecting works or preparing water and drainage schemes.

3. *Agra.*—The pumping plant has worked very smoothly throughout the year. The erection of an extra low lift triple expansion Worthington pump recommended by me is finished, as also the construction of a fourth settling tank necessitated by the increasing demand for water. The Cantonment authorities alone have taken 40 million gallons more than last year, their payments having risen from Rs. 15,455 in 1901 to Rs. 27,006 this year.

The Clear Water Reservoir is to be extended next October at a cost of Rs. 32,000 to cope with the growing demand for water.

The income from water rate, sale of water and other receipts, amounts to Rs. 91,302, thus showing a balance of Rs. 26,912 over expenditure on account of maintenance charges. This is very satisfactory. Mr. Rogers, the Secretary-Engineer, has effected a saving of Rs. 2,380 in the cost of coal by using an improved mica composition patented by him. This is very creditable, and Mr. Rogers deserves special recognition from the Municipal Board on this account. I would recommend that a suitable honorarium be granted him by the Board.

For the first time for several years past there has been no burst this year on the 28" rising main. About 27 miles of drains are now flushed daily by 49 new stop cocks fixed in them instead of using the 3" hydrants as before, and this system results in a great saving of water. The serious break down in Allahabad has set the other Municipalities on their guard, and Agra has ordered two spare pump barrels from England. Financially these water-works have had the most successful year since they started. The net cost per 1,000 gallons of water has been for the last four years as follows :—

1899-1900.	1900-1901.	1901-1902.	and for 1902-1903
3.29 annas.	2.95 annas.	2.24 annas.	1.93 annas.

Great credit is due to Mr. Rogers for his very successful management.

A survey map to a scale of 100 feet to an inch has been received from the Thomason College Press, Roorkee. This will be an invaluable help in laying down connections. A sullage drain and farm has been started on the banks of the Jumna which is expected to yield a revenue of at least Rs. 1,500 besides rendering the water innocuous and preventing it from contaminating the water in the Jumna.

4. *Allahabad.*—There were two accidents to the pump barrels at Karela Bagh during the year under report. One occurred in August 1902, when "B" pump barrel burst and "A" pump barrel was fixed which worked for about 5 months till on the 12th February 1903, its bottom flange burst off. "B" pump barrel was then transferred to "A" Engine and this worked only for 45 hours when the greater part of the bottom flange burst off. Both these pump barrels were received from Messrs. Jessop and Company, Calcutta. This double accident was the most serious that ever happened to any of the Water-Works in these

Provinces and resulted in a partial water famine for some time. The danger anticipated by me in my last Annual Report and in my Inspection Notes, actually occurred. This double accident has brought home to the Municipality the necessity of always keeping spare pump barrels in stock. Two are ordered from England and two from Calcutta.

There is a falling off of about 25 million gallons in the supply of water and this is due to the break down. The income from sale of water, water rate and other receipts, exceeded the maintenance charges by Rs. 52,831, or about 86 per cent - a very creditable balance over expenditure. The cost of coal has exceeded last year's figures by Rs. 843 in spite of a reduction made in the value of coal in August 1902. This increase is chiefly due to an enormous amount of coal being used in the month of March 1903, on account of the break down at Karela Bagh. The advisability of putting in a new triple expansion vertical Worthington pumping engine with high duty attachment and using superheated steam at the river stations of both Allahabad and Benares is under consideration.

5. *Benares*.—Two sets of pump barrels and one set of spare parts were ordered from England and have since arrived and are now being erected. A crack was discovered in the top flange of "C" pump barrel at the river station in November last, but it was readily repaired. An additional lathe, recommended by me, has been purchased to cope with the increasing amount of repairs to pumping machinery. The pumping machinery at the filtered water station has worked satisfactorily during the year. The consumption of filtered water this year is 1,150 million gallons, against 939 of the previous year—an increase of 211 million gallons. The maintenance charges amount to Rs. 68,496 and the income from water rate and sale of water to Rs. 87,605, thus showing a credit balance over working expenses of Rs. 19,109.

The large increase in consumption is largely due to wastage owing to bad house fittings. The Municipality on my recommendation has engaged an experienced Water-Works Inspector in England. He will arrive in July. The Municipality have further arranged that all defective house fittings will be repaired with the best materials and fittings by the Water-Works staff. As there are close upon 5,000 house connections in Benares it will take two or three years before the full benefits of these measures are realized. I do not expect any marked improvement to be shown in the next annual report, as the present consumption is so great that the filtered water engines are unable to cope with it except by increasing the hours of pumping and by working, at the time of greatest demand, at a speed higher than they were designed for.

The expenditure on sewerage works amounted to Rs. 48,311, consisting of the construction of branch sewers, latrines, and pail depôts. All the 17 latrines included in the sewerage scheme have been completed, and 16 out of the 20 pail depôts have been made over complete to the Conservancy Department. The pumping at the Dassasamedh station has been carried on throughout the year except during the rainy season. Experimental anaerobic and aerobic filters and a septic tank to deal with raw excreta at Hingwa Talao, are under construction and will be ready for use shortly. The reduced expenditure on sewerage construction is due to the Assistant Engineer, Mr. Mandy, having resigned to take up a better post. A new Assistant has been appointed from England and will arrive in July next.

The construction of surface drainage has greatly improved the sanitation of the localities where drains have been constructed. The roads along the surface drains have been metalled and detritus pits have been provided. Out of Rs. 56,794 provided in the Budget, Rs. 44,524 has been spent on drainage during the year.

6. *Cawnpore*.—Throughout the year, the pumping machinery at both stations has worked satisfactorily without a break down. It has been

regularly overhauled and necessary repairs and renewals executed. The consumption of water during the year exceeded last year's figures by 124 million gallons, or nearly 17 per cent. The demand for filtered water has steadily increased year by year. It has nearly doubled itself in five years. The amount realized by sale of water has similarly increased. It was Rs. 4,481 in 1895-96 and this year it has risen to Rs. 26,409. The maintenance charges are lower by Rs. 8,379. This is very satisfactory. The capital expenditure on Water Works for the year was Rs. 41,669, of which Rs. 25,110 was spent on the Water Tower which was completed in August last, and since then has been assisting in giving a constant supply to the town. The construction of a new filter, suggested in my last report, was taken in hand on which Rs. 2,439 was spent. The balance was spent on extensions of mains, over two miles of which were laid, flushing connections, tools and plant and Engine drivers' quarters.

The value of coal, in spite of its reduced rate, increased by about Rs. 1,500. This is about covered by the increased consumption of water. One hundred and sixty-one house connections were made and 34 for other than domestic purposes. Nothing appears to have been done by the Military authorities towards introducing the water-supply into Cantonments.

About 3.81 out of the total length of 4.86 miles of the main sewer have been completed and the contractors expect to have it complete before the next rains. Satisfactory progress is being made in connection with the construction of low level and branch sewers. The arching of the Gauda and Sisamau Nalas has been completed. Since the nalas were arched and the surface drains made, the house-owners are gradually constructing pukka drains from their premises and a great improvement is in evidence.

7. *Lucknow*.—The pumping plant has worked smoothly during the year. The demand for filtered water increased by 39 millions or about 8 per cent. There has been a continually increasing demand since 1897-98, resulting in an increased number of house connections every year. The working charges show a decrease of Rs. 703 from last year, and of Rs. 11,254 below the budget allotment, and the receipts from water rate and sale of water show an increase of Rs. 4,866 over last year. There is a net balance of Rs. 12,892 over expenditure and this speaks to the credit of the Superintendent as well as the other Water-Works staff who have effected this great economy in the expenditure, and, at the same time, have kept the machinery and works in excellent order.

The plans and estimates for the surface drainage of Lucknow were prepared by Mr. A. M. Rouse, Assistant Engineer, and the construction is being carried out by Mr. R. W. Thompson, the Municipal Engineer.

8. *Meerut*.—These Water-Works rank above all in these Provinces in giving excellent results, both in the quality of water and in the economy of working. There has, this year, been a small decrease in the consumption of water of 25,12,522 gallons from last year. This is chiefly due to the departure of the military force to the Coronation Darbar and to many of the inhabitants having fled the city through plague scare. The maintenance charges have risen by Rs. 542 over last year, owing to the purchase of a 6 inch lathe at a cost of Rs. 788. The income from sale of water and other receipts amounted to Rs. 32,127.

The turbines have given no trouble and have worked satisfactorily. The number of house connections during the year increased by 14.

9. *Mussoorie*.—In November last I formulated a scheme for improving Mussoorie Water-Works, supplying Landour with water, and for electric lighting of Mussoorie and Landour, and submitted my preliminary report to Government and the Municipal Board. If the scheme is approved, I have no doubt that Mussoorie will greatly benefit by it.

There is an increase of Rs. 2,295 over last year in the working expenses, and a falling off of 329,348 gallons of water in consumption.

10. *Naini Tal.*—There is a decrease of 21,027 gallons of water from that supplied last year. The income from water rate and sale of water exceeded the working charges by Rs. 6,866 or Rs. 131 more than last year. The pumping machinery worked well and gave very little trouble during the year. The consumption of coal increased from 19·8 to 24·1 tons per million gallons and the Superintendent explains that this increase is due to his being without a driver for two months. A connection has now been made from Lake Engines to Bara Nadi. In the event of the spring running short, the supply can be supplemented by the Lake Engines. The number of house connections made during the year was 16.

11. *Farrukhabad.* Certain changes having had to be made in the alignment of the drains, the estimate will have to be revised. Nearly half the construction of drains is completed.

12. *Dehra Dūn.*—The detailed scheme for improving the surface drainage of the town, which was prepared last year, has been sanctioned by Government.

13. *Aligarh.*—The construction of outfall drains for sullage of the town is nearly half completed.

14. Surveys are in progress in Azamgarh, Gorakhpur, Haldwani, Sahāranpur, Chandausi and Hathras, with the view of preparing drainage projects for these towns. Projects for the drainage of Nāgina, Deoband and Fyzabad are under preparation.

15. *Delay in submission of report.*—The delay is due to the late receipt of the necessary information from some Municipalities.

D. W. ALKMAN,

Superintending Engineer,

Sanitary Engineer to Government,

United Provinces

NAINI TAL :
The 13th May 1903. }

APPENDIX.

Statement of operations

		Agin.	Allahabad.	Benares.
<i>Population.</i>				
By Census of 1901 in Municipality	...	105,981	159,515	204,373
Ditto Cantonments	..	22,041	12,487	4,958
Total	...	128,022	172,002	209,331
<i>Cost of Works.</i>				
Initial capital cost	... .. Rs.	11,70,761	16,24,063	25,61,881
Cost of extensions and improvements to end of previous year	... .. "	223,688	80,725	91,289
Cost of extensions and improvements during year	... .. "	43,990	195	23,959
Total, Cost of works	... .. "	14,38,439	17,04,983	26,77,129
<i>Consumption of filtered water.</i>				
During year, including Cantonments	... Gallons.	656,214,070	565,124,915	1,150,143,229
Daily average ditto	... .. "	1,797,298	1,548,287	3,151,077
Maximum daily average in any one month.	... .. "	2,517,091	2,576,000	4,328,322
Daily average for Cantonments alone	... .. "	273,590	147,458	1,608
Average number of hours filtered water pumped daily	... .. "	7.76	11.26	8.99
<i>Annual Charges and Receipts.</i>				
Maintenance charges	... .. Rs.	64,390	61,250	68,496
Total charges with interest and payment of loan	... .. "	1,45,422	1,61,361	1,53,340
<i>Income from Water-Works.</i>				
Water rate recovered during year	... .. Rs.	54,455	87,571	81,911
Sales of water and other receipts	... .. "	36,847	26,510	5,694
Total, Income	... .. "	91,302	1,14,081	87,605
<i>Number of house connections at end of year.</i>				
For purely domestic purposes	... .. "	690	1,691	4,789
For other purposes	... .. "	99	125	77
Total	... .. "	789	1,816	4,866
Number of connections with meters	... .. "	80	164	77

NAINI TAL :

The 13th May 1903.

WATER-WORKS.

during the year 1902-1903.

Cawnpore.	Lucknow.	Meerut	Mussoorie.	Naini Tal.
172,671 24,496	240,649 23,400	78,740 39,389	14,659 3,711	14,220 944
197,170	264,049	118,129	18,400	15,164
14,41,353 93,970 41,670	16,10,847	7,51,710	64,186 7,112 1,746	2,47,000 2,87,914 739
15,76,993	16,10,847	751,710	73,044	5,35,653
856,693,797 2,347,106 2,998,662 ... 14.32	495,171,795 1,356,635 2,096,212 233,698 8.36	173,155,769 474,399 862,306 226,303 12.95	7,499,865 38,070 31,134 ... 15.80	22,717,237 40,547 61,967 1,220 7.21
64,433 1,18,423	42,676 1,18,622	21,572 64,724	12,690 15,498	20,034 23,014
... 30,394	21,503 34,065	30,000 + 2,127	... ...	25,551 1,348
30,394	55,568	32,127	...	26,899
490 161	486	110 1	... ...	54 1
651	486	111	...	55
132	28	12	...	52

D. W. AIKMAN,
*Superintending Engineer,
 Sanitary Engineer to Government
 United Provinces.*

SEVENTH ANNUAL REPORT
OF THE
SANITARY ENGINEER
TO
GOVERNMENT, U. P. OF AGRA AND OUDH,
FOR THE YEAR ENDING 31st MARCH 1902.



ALLAHABAD:
Printed at the United Provinces of Agra and Oudh Government Press.
1902.

Seventh Annual Report of the Sanitary Engineer to Government, United Provinces of Agra & Oudh, for the year ending 31st March 1902.

THE post of Sanitary Engineer to Government was held for six months by Mr. W. B. Gordon, Superintending Engineer; for three months by Mr. N. F. Mackenzie, Executive Engineer; and for the rest of the year by Mr. D. W. Aikman, Executive Engineer, Public Works Department.

2. Besides the eight Water Works Stations, the Sanitary Engineer during the year under report visited Aligarh, Barcilly, Bara Banki, Budaun, Chandausi, Dehra Dún, Deoband, Fyzabad, Gorakhpur, Muzaffarnagar, and Saháranpur for the purpose of inspecting works or preparing water and drainage schemes.

3. *Agra*.—The pumping plant has worked well during the year, although the low lift pumps, during the season of greatest demand, have had to work *continuously*.

The demand for filtered water increased during the year by 126,923,146 gallons; an increase of 26 per cent. A break down in one of the low lift pumps would have caused a serious water famine. To guard against this, the Municipality, on the recommendation of the Sanitary Engineer, have applied to Government for a loan of Rs. 27,000 to defray the cost of an extra low lift pump. The new pump will be a triple expansion Worthington, capable of delivering 3,000 gallons per minute into the settling tanks. Owing to the increasing demand it was found necessary to construct an extra settling tank. This is nearing completion and is expected to be in use by the end of May 1902.

The income from sale of water has increased by Rs. 10,335 equal to an increase of 25 per cent., while the cost of delivering the water has only increased by Rs. 5,259 or less than 10 per cent. This is very satisfactory and is very creditable to the Municipal Engineer and the staff under him.

The debit balance between the working charges and the income from the sale of water is rapidly diminishing. In 1899-1900 the deficit amounted to Rs. 15,586, in 1900-1901 to Rs. 11,702 and for last year it was only Rs. 6,627.

4. *Allahabad*.—The pumping machinery has worked well throughout the year. The pump barrels of the River Station pumps are much worn, that of "A" Engine has cracked. New pump barrels were ordered from Calcutta in August 1901. There has been a great delay in their delivery. This is a serious matter as an accident to the other engine would mean a complete water famine, until it was repaired. The demand for filtered water exceeded that of last year by 43,802,471 gallons. The income from sale of water, water rate, &c., exceeded the working expenses by Rs. 50,436. Although this is only a slight increase over last year yet it is very creditable, as most of the extra water pumped was used for more liberal flushing of the drains on account of the plague and brought in no money return.

5. *Benares*.—The new boiler at the river pumping station has worked satisfactorily since it was started in September last. Both pumping installations have worked well throughout the year. Additional lathes are required in the workshop to meet the increasing amount of repairs due to fair wear and tear of pumping machinery, standposts, &c.

Two hundred and eighty-eight new house connections were made during the year. The consumption of filtered water increased by 28,764,322 gallons, while the maintenance charges decreased by Rs. 2,728. The total maintenance charges amounted to Rs. 68,966. This sum includes

the cost of a coal-shed, an extra boiler, a weigh bridge and other original works amounting to Rs. 10,532. The receipts from the sale of water and water rates amounted to Rs. 84,954, showing a credit balance over working expenses of Rs. 26,520.

The expenditure on sewerage works amounted to Rs. 1,04,720 and included the construction of six branch sewers, nine latrines completed and opened and three nearing completion, eight pail-depôts completed and three under construction, four urinals, two bathing platforms, a flushing gate on the Dassasumedh sewer, and much has been done for surface drainage, doing away with the objectionable *nābdāns*. The works have been carried out departmentally by petty contract; all works have been excellently done. The economy in construction is best shown by an example. The estimate for the Kabeer Chaura Branch Sewer was Rs. 9,900, the lowest tender was Rs. 13,159. The actual cost of the work including a flushing tank not estimated for was Rs. 7,996.

6. *Cawnpore*.—The pumping plant worked well during the year. The demand for water increased by 76,784,131 gallons (nearly 12 per cent.) while the cost of coal used was less by Rs. 434, a most satisfactory result. The total maintenance charges were higher by Rs. 7,101; this was due chiefly to larger expenditure on river training, on sand for renewing filters, in the purchase of meters and to more expensive repairs due to wear and tear. The expenditure on oil and waste (Rs. 2,535) appears to be high. The capital expenditure on water-works for the year was Rs. 25,512 out of which Rs. 21,930 was spent on the water tower, and the balance on extension of the mains and flushing connections. The consumption of water in the last two years has risen by 186 million gallons or over 33 per cent.; a new filter is necessary to meet the extra demand. The revenue from the sale of water was Rs. 23,820, an increase of nearly 15 per cent. on last year. The house connections have increased during the year by 156. Some correspondence has taken place with the military authorities which, it is hoped, will ultimately lead to the extension of the water-works to the Cantonment.

The estimate for the main connecting sewer was sanctioned in January 1902, and satisfactory progress has been made in construction. The capital expenditure for the year was Rs. 22,335. Considerable progress has been made in the arching of the Ganda and Sisamau Nalas on which Rs. 5,307 has been spent from revenue.

7. *Lucknow*.—The pumping machinery has worked well during the year. The demand for filtered water increased by over 54 million gallons or nearly 12 per cent. The working charges were Rs. 7,955 less than last year. The receipts from the sale of water and water-rate for the first time exceeded the working charges, and exceeded them by Rs. 7,341. Credit is due to Mr. Robertson and his staff who have done much to economise expenditure and at the same time have kept the machinery and works in excellent order. A scheme is under preparation for the surface drainage of Lucknow for which the services of Mr. A. M. Rouse (F. C. H.), Assistant Engineer, have kindly been lent by Government.

8. *Meerut*.—These water-works continue to give excellent results, both in the quality of the water and in the economy of working. The demand increased by over two million gallons and the working charges decreased by Rs. 4,606. The revenue from the sale of water exceeded the working charges by Rs. 10,232. The quantity of water supplied to the Cantonment increased by nearly 34 per cent. There is a large falling off in consumption of filtered water outside the Cantonment amounting to about 19 million gallons in the year, which I am unable to account for. The explanation given in last year's report does not now seem to meet the case.

9. *Mussoorie*.—The increasing popularity of Mussoorie as a summer resort has rendered the present water supply insufficient to fully

meet the demand. Search has been made for new springs to increase the supply, but without much success. The most promising scheme appears to be the utilization of the Kempti falls to generate power which can be transmitted electrically to drive pumps at some springs two miles nearer Mussoorie. By constructing a collecting reservoir at these pumps, the power could be used for pumping during the day time and for lighting Mussoorie by night. The revenue from electric lighting would, I expect, go a long way to defray the interest and sinking fund on the initial outlay. Observations are being taken to determine the minimum discharge of the springs and the minimum power to be derived from the falls. Should these turn out satisfactory, I hope to be able to formulate a scheme that will meet with the approval of the Municipality and Government.

10. *Naini Tal*.—The demand for water was less last year. The high level springs gave nearly $1\frac{1}{4}$ million gallons more water. The income from water rate and sale of water amounted to Rs. 31,606 and exceeded the maintenance charges by Rs. 6,435, an improvement of Rs. 450 on last year. The number of house connections increased by 11 during the year.

11. *Dehra Dún*.—A detailed scheme for improving the surface drainage has been prepared and will shortly be submitted for sanction.

12. *Saháranpur*.—Improvements in the flushing arrangements for drains have been carried out.

13. *Aligarh*.—The construction of outfall drains for sullage is in progress.

14. *Farrukhabad*.—A drainage scheme (Rs. 75,000) is being carried out departmentally.

15. *Delay in submission of report*.—The delay is due to the late receipt of the necessary information from several Municipalities.

LUCKNOW :	}	D. W. AIKMAN, SUPD. ENGR.,
The 6th May 1902.		Sany. Engr. to Govt., U. P. of Agra and Oudh.

		Agra.	Allahabad.	Benares.
<i>Population.</i>				
By Census of 1901 in Municipality	...	165,981	159,545	204,373
Ditto Cantonments	...	22,041	12,487	4,958
Total	...	188,022	172,032	209,331
<i>Cost of Works.</i>				
Initial capital cost	... .. Rs.	1,170,761	1,624,063	2,561,881
Cost of extensions and improvements to end of previous year	... .. "	217,011	80,408	80,757
Cost of extensions and improvements during year	... .. "	6,677	317	10,532
Total cost of works	... .. "	1,394,449	1,704,788	2,653,170
<i>Consumption of filtered water.</i>				
During year including Cantonments	... Gallons.	614,337,187	589,987,040	939,756,463
Daily average ditto	... .. "	1,683,116	1,616,402	2,574,675
Maximum daily average in any one month	... .. "	2,160,776	2,398,703	3,060,822
Daily average for Cantonments alone	... .. "	...	167,486	1,810
Average number of hours filtered water pumped daily	... .. "	7.80	10.72	8.2
<i>Annual Charges and Receipts.</i>				
Maintenance charges	... .. Rs.	60,150	55,097	58,434
Total charges with interest and payment of loan	... .. "	139,647	155,199	...
<i>Income from Water-Works.</i>				
Water-rate recovered during year	... .. "	Nil.	80,665	81,605
Sales of water and other receipts	... .. "	53,523	24,869	3,349
Total, Income	... .. "	53,523	105,534	84,954
<i>Number of house connections at end of year.</i>				
For purely domestic purposes	... .. "	632	1,562	265
For other purposes	... .. "	117	150	23
Total	... .. "	749	1,712	228
Number of connections with meters	... .. "	76	150	23

The 6th May 1902.

WATER-WORKS.

during the year 1901-1902.

Cawnpore	Lucknow.	Meerut.	Mussoorie	Natal Til.
172,671	240,650	78,740	14,689	11,220
24,496	23,400	39,390	3,711	944
197,170	264,050	118,130	18,400	15,164
1,111,353	1,610,847	751,710	52,195	247,000
68,158	...	..	4,201	39,412
25,512	...	...	7,787	1,511
1,535,323	1,610,847	751,710	64,186	287,923
732,770,017	456,369,677	175,668,291	7,829,213	22,738,264
2,007,589	1,250,327	481,283	21,450	62,296
2,530,000	1,603,661	1,170,391	40,841	136,028
...	188,767	232,950	...	1,590
13.30	7.9	12.11	15.6	10.39
73,312	43,379	21,030	10,395	25,171
127,302	119,325	64,182	13,201	31,521
Nil.	21,945	1,262	Nil.	28,960
23,820	28,775	30,000	"	2,646
23,820	50,720	31,262	...	31,606
336	435	96	Nil.	11
142	...	1	...	2
478	435	97	"	13
117	19	12	Nil.	36

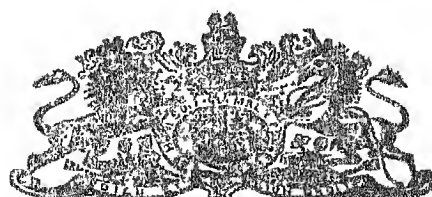
D. W. AIKMAN, SUPDG. ENGR.,
Sany. Engr. to Govt., U. P. Agra and Outh.

SIXTH ANNUAL REPORT
OF THE
SANITARY ENGINEER

TO

GOVERNMENT, N.-W. PROVINCES AND OUDH,

FOR THE YEAR ENDING 31st MARCH 1901.



ALLAHABAD:

Printed at the Government Press, North-Western Provinces and Oudh.
1901.

*Sixth Annual Report of the Sanitary Engineer to Government,
North-Western Provinces and Outh, for the year ending 31st
March 1901.*

The post of Sanitary Engineer to Government was held during the year by Mr. W. B. Gordon, Superintending Engineer, Public Works Department. During his absence on three months' privilege leave (from 26th July to 28th October) Mr. F. Clayton, Executive Engineer, Bhábar and Taráí Canals, carried on the current duties of the office.

2. The following places were visited by the Sanitary Engineer during the year for the purpose of inspecting works or preparing water and drainage schemes :—

Serial No.	Town visited.	Object of visit.	Remarks.
1	Agra ...	Inspection of water-supply and drainage ...	4 visits.
2	Aligarh ...	Ditto the city drainage ...	2 do.
3	Allahabad ...	Ditto water and drainage works ...	5 do.
4	Bareilly ...	Ditto drainage ...	1 visit.
5	Benares ...	Ditto water and sewerage works ...	3 visits.
6	Cawnpore ...	Ditto water, sewerage, and river training works.	8 do.
7	Dehra Dún ...	Ditto preliminary survey for drainage,	3 do.
8	Farrukhabad ...	Ditto ditto ditto	2 do.
9	Gházípur ...	Ditto opium factory fire-protection...	1 visit
10	Haldwani ...	Ditto waterworks ...	1 do.
11	Lucknow ...	Ditto ditto ...	5 visits.
12	Mussoorie ...	Ditto ditto ...	2 do.
13	Naini Tál ..	Ditto ditto drainage ...	4 do.
14	Saháranpur ...	Ditto the drainage of the town ...	1 visit.

3. *Agra.*—The new filter was completed and brought into use in October. The increase in filtering area, and the consequent reduction in the rate of filtration, has led to a marked decrease in the number of microbes found in the filtered water, which is now of a remarkably pure quality. The new training works have kept the main stream of the river close to the intake well, and the conditions at the intake are very satisfactory. The condemned boilers have been replaced by four new boilers of the best make, fitted with all the latest improvements. The compound of the water-works has been enclosed by a suitable fence, and some additional land has been acquired. The insanitary shrubberies have been removed and the grounds cleared and laid down with grass. The pumps and engines have been thoroughly repaired. The pumps of the Lansdowne and Octopus engines have been fitted with new barrels; counterpoises have been attached to the connecting rods of both beam engines. Necessary spare parts have been procured for the pumping machinery. A store-room has been provided. A new workshop has been built to replace the original building, which had to be removed to give room for the new filter. The electric light has been put into working order. In fact all the numerous defects which were found to exist in the condition and management of these water-works just before the present Municipal Engineer, Mr. Rogers, assumed charge, have now been remedied.

There is a marked decrease in the consumption of water compared with the previous year. This is due chiefly to Mr. Rogers' excellent arrangements for filling the cantonment reservoir during ordinary pumping hours. His predecessor had found it necessary to pump extra hours for

this purpose—an arrangement which led to increased consumption of both fuel and water.

Compared with the previous year there is a substantial saving of Rs. 2,536, or nearly 11 per cent., in the value of the coal consumed in the boilers.

The preparation of the detailed plans and estimates for an intercepting sewer has again been put in hand, experience having shown that the sullage of the city cannot be satisfactorily disposed of in any other way.

4. *Allahabad*.—The volume of unfiltered water pumped to the filtering station is close upon 10½ million gallons less than in the previous year, while the amount of filtered water supplied has increased by over two millions. This is good evidence of the saving effected by the works carried out to prevent loss of water by leakage from the tanks and filtering beds. During the past three years the volume of water lost by leakage and evaporation from the settling, filtering, and storage tanks has been as follows —

	Gallons		
In 1898-1899 51,913,901
" 1899-1900 32,101,430
" 1900-1901 21,581,281

Improvements are still being made in the pumping machinery at the river station. The air chamber on "A" suction has been moved up close to the pump. Reflux valves have been fitted on the delivery pipes in the basement of the engine-house. The Meldrum's furnaces fitted to the boilers at this station in the previous year have led to economy in the consumption of coal. Compared with the previous year there is a decrease of over Rs. 1,000, or 10 per cent., in the value of the coal consumed.

The Municipal Board propose to spend Rs. 40,000 on improving the drainage of the town. The preparation of the detailed estimates is being put in hand.

5. *Benares*.—An estimate (Rs. 6,000) was sanctioned for erecting an extra boiler at the river pumping station. The boiler has been ordered, and should arrive in July. Although 231 additional house connections were laid during the year, the consumption of filtered water was nearly 60 million gallons less than in the previous year. This satisfactory decrease of over 160,000 gallons in the average daily consumption is due to the pressure in the mains having been reduced and to the measures taken by the Pipe Line Inspector, under the Resident Engineer's directions, for the reduction of waste from the standposts and house taps. The value of the coal consumed is Rs. 2,392, or over 10 per cent., less than in the previous year; but, in spite of this satisfactory decrease, there is an increase of Rs. 14,519 in the total maintenance charges, which is ascribed to payments of bills outstanding from the previous year and to special expenditure on the renewal of parts of the pumping machinery. Part of the excess is due to an increase of Rs. 3,451 in the value of the coal in stock at the end of the year and part to expenditure on extensions of pipe lines having been charged against "maintenance" instead of against "original works." The expenditure on "sewerage works" during the year amounts to Rs. 99,019 against a budget allotment of Rs. 150,700. Of the total outlay, Rs. 34,044 was spent on the construction of branch sewers in the old sewered area and Rs. 23,771 on the construction of latrines and pail depôts. The work of diverting the contents of the old Trilochan and Dassasumedh sewers into the new main sewer and other works designed to prevent the pollution of the river were carried to completion. Thus one important object of the sewerage works has been attained. In the "sewered" area five branch sewers were under construction, of which three were completed within the year. House connections have been made along the Bengalitola and Agustkunda branch sewers. When the revised estimate for the works was under discussion it was decided that all available funds should be devoted to the

construction of branch sewers in the "sewered" area and of latrines and pail depôts. It has, however, been found necessary to construct an additional branch sewer—the Kabichaura—for the drainage of an insanitary part of the "unsewered" area. Ten new latrines were under construction, of which four were completed. At many of the sites it has been found necessary to provide a much larger number of seats than was originally proposed. The new pattern of latrine appears to give general satisfaction. Six pail depôts were completed. Full details of the year's operations will be found in the annual progress report of the Resident Engineer (Mr. Lane Brown). The progress made is very satisfactory, considering the difficult nature of the work and the fact that an outbreak of plague interfered seriously with the labour-supply during the best part of the working season.

6. *Cawnpore*.—An expenditure of Rs. 8,986 was incurred on the following works for improving and extending the water-supply:—Constructing a water tower or balancing reservoir at Benajhabar; providing extra sluice valves on the distributing main; extending the distributing mains; flushing connections; and river training works.

The construction of a water tower has been under consideration for some years past, and several designs have been prepared. It has been finally decided to construct a circular steel tank 50½ feet high and 36 feet in diameter. The tank will be erected on a masonry plinth, 12 feet above ground-level, and will contain 320,000 gallons. The plans and estimate (Rs. 55,353) have been submitted to Government for sanction. Experience has shown that extra sluice valves are required on the 28-inch main to admit of its speedy repair in the event of a breach. These are now being provided. New three-inch mains of an aggregate length of 2,655 feet were laid during the year for extending the water-supply; and 11,420 feet of connecting pipes were laid to facilitate the flushing of street drains. Two years ago the course of the main stream lay along the left bank at a distance of nearly a mile from the intake of the water-works. The cost of cutting and maintaining a channel to bring water to the intake well involved an annually-recurring expenditure of over Rs. 8,000. By constructing two small tree spurs, and by cutting a zig-zag channel about 30 feet wide, the stream has now been diverted into the best possible course—that is, while avoiding the village of old Cawnpore, it passes quite close to the intake. This alteration in the course of the river has long been desired on both sanitary and financial grounds. The total cost of the river training works was under Rs. 15,000. Compared with the previous year there is a satisfactory decrease of over Rs. 4,000 in the annual maintenance charges in spite of the fact that extra expenditure was incurred on fuel and establishment so as to maintain the supply constant during the three months of dry hot weather. For some reason which has not been explained the cost of coal per million gallons pumped at the river pumping station works out to Rs. 21·25 against Rs. 19·25 in the previous year. The total consumption of filtered water during the year is shown as 656 million gallons approximately. This figure represents the volume of water actually pumped; but of this, during hours of low demand, nearly 10 per cent. was returned to the clear water reservoir through the bye-pass provided for the purpose. This accounts also for the excess in volume of filtered water pumped over that of unfiltered. There is again a satisfactory increase in the receipts from sales of water.

The question of the best method of disposing of the sewage of the town was still under consideration at the commencement of the year. It was found that the cost of acquiring the only site in the vicinity of the town likely to prove suitable for the bacterial treatment of the sewage would be very great; and the Sanitary Engineer to Government estimated that the ultimate cost of disposing of the sewage at this site would probably be greater than that of conveying it through the cantonments, as

originally proposed by Mr. Baldwin Latham. He therefore advised the Municipal Board to carry out the following works —

- (1) A main intercepting sewer starting from the Sisaman Nāla and carrying its contents by gravity to a point immediately below the Dubka Nāla at the south-eastern boundary of cantonments.
- (2) A low-level system of sewers to intercept and convey to the main sewer the drainage from the factories and bāzārs lying between the North-Western Tannery and the Permit Bāzār.
- (3) A branch sewer to connect the Sidar Bāzār with the main sewer.

These works would prevent the pollution of the river by the sullage and surface drainage of the city which now enters it above the bathing-ghats and above cantonments, and would provide an outfall for the internal branch sewerage system of the city which would hereafter be constructed. All the works were to be designed on the "separate" instead of the "combined" system previously recommended. The cost of the works was estimated roughly at five lakhs. The Sanitary Engineer also advised that the open drain known as the "Ganda Nāla" should be covered over, experience having shown that it is otherwise impossible to prevent the drain being used as a receptacle for rubbish and night soil. The Municipal Board unanimously approved of these proposals, and Government have been asked to provide the necessary money from loan funds for the construction of the intercepting sewers. The detailed plans and estimates were put in hand and were nearly completed by the end of the year.

7. *Lucknow*.—Of the total volume pumped at the river station, 55 million gallons were supplied for the irrigation of the Victoria and Husainabad Parks. By the close of the year the Trustees of the Husainabad Endowment Fund had completed their arrangements for the irrigation of the Parks by means of pumping machinery erected near the Machahli Bhūwan. The buildings and distribution system were designed by Mr. A. Gale, Executive Engineer, Public Works Department, under the general supervision of the Sanitary Engineer to Government, who also arranged for the supply of the pumping machinery by Messrs. James Simpson & Co.

The slight excess in the cost of maintaining the water-works as compared with the previous year is far more than covered by the extra outlay incurred in procuring a better quality of sand from the Gogra river.

At the request of the Municipal Board the Sanitary Engineer to Government inspected the cantonment drains and gave his opinion as to the best alignment for the proposed new outfall drain.

8. *Meerut*.—The maintenance charges are Rs. 4,258 in excess of those for the previous year. Part of the excess appears to be due to the investment of Rs. 2,000 to cover depreciation of machinery, no investment having been made in the previous year. Over one-third of the total volume of water supplied was used in cantonments. The decrease in the consumption of water outside of cantonments noticed in last year's report is said to be due to a decrease in the quantity wasted in changing the water in the storage tanks. With the increase in the total consumption of water there is now no risk of the water in the tanks stagnating and no need to waste water in emptying the tanks periodically.

9. *Mussoorie*.—In accordance with instructions received from His Honor the Lieutenant-Governor, the Sanitary Engineer to Government visited Mussoorie in December and reported on the measures which should be adopted for the immediate improvement of the water-supply. His recommendations, which involved an expenditure of about Rs. 10,000, were accepted by the Municipal Board and are now being carried out. He also advised that further search should be made for springs likely to be of use in extending the supply, and that systematic observations should be made of the discharges of all such springs and of all streams likely to yield sufficient water-power for pumping purposes.

The Board have arranged for these observations.

10. *Naini Tal*.—An expenditure of Rs 10,106 was incurred during the year on works connected with the extension and remodelling of the water-supply, chiefly on the construction of two iron storage tanks on Tonnochy's Hill. The cost of these tanks has been met from Provincial funds.

The maintenance charges for the year are Rs 6,000 more than was anticipated when the estimate for the recent extension was framed. About Rs 1,500 was paid early in the year for coal used in the previous year; the balance of the excess is due to extra expenditure on fuel for pumping. The high-level springs were estimated to yield 13½ million gallons in an average year. During the past year they yielded just under eight million gallons. The pumps were called upon to make up more than the deficiency, as the consumption of water in this system is higher than was estimated. The excessive consumption has been brought to the notice of the Board, and they have been advised to reconsider the question of the rate to be charged for water supplied through house connections. So long as the present rate of Rs. 3 per thousand gallons remains in force, it does not seem likely that there will be any great increase in the number of house connections. Until the houses are connected the public tanks cannot well be removed; but so long as the tanks are in existence, water will be used without measurement for the irrigation of gardens and for other non-domestic purposes.

An estimate has been sanctioned for constructing 50 *dhobis' ghāts* in the Ballia ravine.

11. *Rājpur and Dehra Dān*.—The improvements carried out last year by Mr. Campbell on the branch line leading to the jail have given such an ample supply of water along this line that the Board have decided to carry the surplus water to the village of Karanpura. The estimate has been sanctioned, and this long-needed extension is now being laid.

The surveys in connection with the project for improving the drainage of the town have been completed, and the detailed plans and estimates are under preparation. Plans for new meat-markets were prepared in the Sanitary Engineer's office. The estimate (Rs. 7,500) was sanctioned and the markets are now being constructed.

12.—*Sahāranpur*.—The work of improving the Craigie Nāla was practically completed by the end of the year. Improvements have also been made in the arrangements for flushing the drains of the town.

13. *Aligarh*.—Detailed plans and estimate (Rs. 11,854) for the construction of outfall drains for the sullage of the town were completed and submitted to the Municipal Board for approval; also a plan and estimate for a new slaughter-house.

14. *Farrukhabad*.—Detailed plans and estimate (Rs. 75,000) for the drainage of the town were prepared, and will shortly be submitted to the Municipal Board.

15. *Amroha, Moradabad district*.—A design and estimate were prepared for a new slaughter-yard.

16. *Delay in submission of returns*.—This report should have been submitted on the 1st of May. The returns from the Resident Engineer of Cawnpore were not received until the 16th, and from the Resident Engineer of Benares until the 20th, of the month. The Resident Engineer of Benares reports that in order to submit his returns by that date his office establishment had to work overtime.

W. B. GORDON, SURDG. ENGR.,

Sanitary Engineer to Government, N.-W. P. and Oudh.

The 24th May 1901.

TABLE N o. I.

Statement showing progress on Sanitary Works supervised by the Sanitary Engineer during 1900-1901.

Name of municipality.	Serial No.	Nature of work.	Amount of estimates.	Expenditure	
				During 1900-1901	Total spent up to 31st March 1901.
			Rs.	Rs.	Rs.
Agra ...	1	Construction of fourth filter ...	32,000	18,901	33,129
	2	Erection of new boilers ...	34,655	35,321	35,321
	3	Spare parts of machinery ...	3,308	3,308	6,590
	4	Spare pipes and collars ...	1,416	1,416	1,416
	5	Land compensation ...	1,505	1,505	1,505
Allahabad,	6	Moldrum's furnaces for boilers at Karela Bāgh.	2,290	616	2,290
Benares ...	7	Water-works raised reservoir...	79,236	12,631	82,655
	8	Sewerage works ...	13,00,000	99,018	9,02,407
Cawnpore...	9	Water tower ...	55,353	327	327
	10	Sluice valves on main ...	4,297	2,554	2,554
	11	Extension of mains ...	3,300	1,816	1,816
	12	Flushing extension ...	4,200	3,948	3,948
	13	River training works ...	1,500	340	340
Mecrat ...	14	Venturi meter ...	2,000	2,000	2,000
Mussoorie...	15	Enclosing Chalmers' khad spring.	...	330	330
Naini Tal...	16	Water-works—iron tanks on Tonnochy's Hill.	7,341	6,827	6,827
	17	Drainage works—modification of manholes.	...	295	295
	18	Remodelling water-supply ...	2,55,000	3,828	2,23,047
Sahāranpur.	19	Remodelling Craigie Nāla ...	11,921	9,706	9,706
	20	Tanks for flushing drains ...	9,085	400	400

W. B. GORDON, Surda. ENGR.,
Sanitary Engineer to Government, N.-W. Provinces and Oudh.

TABLE No. III.

Comparative Statement of the working of the water-works in the North-Western Provinces and Oudh from 1898-99 to 1900-1901.

	Agra.			Allahabad.		
	1898-1899.	1899-1900.	1900-1901.	1898-1899.	1899-1900.	1900-1901.
DATE OF OPENING.	3rd November 1890.			26th March 1891.		
Population.						
Provided for in scheme, including cantonments.	...	1,000,000	...	...	1,34,000	...
According to census of 1891—						
In municipality ...	...	1,46,208	...	...	1,62,896	...
In cantonments ...	...	23,301	...	...	12,351	...
Total ...	...	1,69,509	...	...	1,75,246	...
Cost of Works.						
Initial capital cost ...	...	...	Rs. 11,70,761	...	...	Rs. 16,24,063
Cost of subsequent works ...	...	...	2,18,651	...	...	75,999
Consumption of Water.						
	Galls.	Galls.	Galls.	Galls.	Galls.	Galls.
For whole year, including cantonments.	554,682,664	532,821,434	487,514,039	514,733,706	544,143,100	546,184,569
Daily average with cantonments ...	1,520,000	1,459,785	1,335,655	1,410,229	1,490,803	1,490,400
Maximum ditto in any one month.	20,20,961	1,807,980	1,894,204	19,05,082	2,134,190	2,147,531
Daily average for cantonments alone ...	164,000	156,679	158,715	111,900	126,355	124,320
Daily maximum allowed in scheme for cantonments.	...	250,000	...	About 200,000		
Total daily supply provided for { in the scheme.	1,500,000 2,000,000	gallons for engines ditto pipes		2,000,000 gallons ultimately to 2,850,000 gallons		
Average number of hours filtered water pumped per diem.	8-93	8-70	7-60	9-82	10-72	9-86
Per head of population per diem.						
As provided in the scheme ... {	15 20	gallons for engine power ditto pipes		15 gallons all round.		
As actually delivered on the census population.	Galls. 8-96	Galls. 8-61	Galls. 7-88	Galls. 8-04	Galls. 8-51	Galls. 8-54
Maximum ditto ditto in any one month.	11-5	10-6	11-23	10-8	12-2	12-3
Annual Charges.						
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
(1) For delivering filtered water ...	55,303	56,434	54,891	49,354	54,854	52,222
(2) With interest and repayment of loan	134,211	151,807	133,118	147,472	158,432	152,324
Income from sale of water, &c. ...	42,966	40,848	43,189	17,392	22,426	20,979
Net annual expenses, inclusive of interest and sinking fund.	91,245	110,959	89,929	130,080	136,006	1,31,345
Water-rate recovered during year ...	...	...	...	80,789	81,355	81,197
Actual cost of filtered water.						
	Annas.	Annas.	Annas.	Annas.	Annas.	Annas.
Per 1,000 { For delivery of water ...	1-58	1-69	1-80	1-58	1-61	1-53
gallons. { On gross charges ...	3-87	4-55	4-37	4-38	4-66	4-46
{ On net charges ...	2-63	3-31	2-95	3-11	3-41	3-84
For delivering water per head of population.	5-22	5-33	5-18	4-50	5-00	4-76
Number of house connections ...	654	674	687	1,327	1,447	1,574

TABLE No. III.

Comparative Statement of the working of the water-works in the North-Western Provinces and Oudh, from 1898-99 to 1901—(continued).

	Benares.			Cawnpore.		
	1898-1899	1899-1900	1900-1901	1898-1899	1899-1900	1900-1901.
	18th November 1892			17th March 1894.		
DATE OF OPENING.						
Population.						
Provided for in scheme, including cantonments.	...	200,000	...	...	210,000	...
According to census of 1891—						
In municipality ...	...	211,586	...	...	162,179	...
In cantonments ...	...	6,299	...	...	21,938	...
Total ...	..	217,885	..	...	188,712	...
Cost of Works.						
Initial capital cost ...	...	...	Rs. 52,61,881	...	...	Rs. 14,41,353
Cost of subsequent works ...	...	...	77,797	...	...	55,404
Consumption of water.						
	Galls.	Galls.	Galls.	Galls.	Galls.	Galls.
For whole year, including cantonments.	852,670,719	970,202,713	910,992,141	522,645,903	546,612,075	655,985,888
Daily average with cantonments ..	2,336,084	2,658,089	2,495,869	1,431,901	1,501,681	1,797,221
Maximum ditto in any one month.	2,537,668	3,132,120	3,077,925	1,604,650	1,793,161	2,744,188
Daily average for cantonments alone,	Supply not extended to cantonments.			Supply not extended to cantonments.		
Daily maximum allowed in scheme for cantonments.						
Total daily supply provided for in the scheme.	...	1,000,000	...	...	4,000,000	...
Average number of hours filtered water pumped per diem.	8-00	8-20	8-18	10-50	10-50	12-55
Per head of population per diem.						
As provided in the scheme ...	20 gallons all round			20 gallons all round.		
	Galls.	Galls.	Galls.	Galls.	Galls.	Galls.
As actually delivered on the census population.	11-04	12-20	11-30	8-74	9-17	10-73
Maximum ditto ditto in any one month.	12-00	14-80	15-15	8-50	9-50	14-54
Annual Charges.						
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
(1) For delivering filtered water ...	63,353	60,583	71,694	68,902	70,206	66,211
(2) With interest and repayment of loan	148,197	1,45,427	1,56,528	1,23,892	1,24,196	1,20,201
Income from sale of water, &c.	2,256	5,628	1,430	15,897	19,194	20,820
Net annual expenses, inclusive of interest and sinking fund.	145,941	139,799	155,108	1,06,995	1,05,002	99,380
Water-rate recovered during year ...	111,189	88,426	81,271	...	...	...
Actual cost of filtered water.						
	Annas.	Annas.	Annas.	Annas.	Annas.	Annas.
Per 1,000 { For delivery of water ...	1-19	1-01	1-28	2-03	2-05	1-60
gallons. { On gross charges ...	2-79	2-42	2-75	3-76	3-63	3-00
{ On net charges ...	2-73	2-30	2-72	3-27	3-07	2-42
For delivering water per head of population.	3-34	4-58	5-22	6-73	6-88	5-60
Number of house connections ...	3,854	4,071	4,302	200	273	342

TABLE No III.

Comparative Statement of the working of the water-works in the North-Western Province and Outh, from 1898-1899 to 1900-1901--(continued).

	Lucknow.			Meerut.		
	1898-1899.	1899-1900.	1900-1901.	1898-1899.	1899-1900.	1900-1901.
DATE OF OPENING.	5th July 1894.			6th May 1896.		
Population.						
Provided for in scheme, including cantonments.	...	200,000	...	...	120,000	...
According to census of 1891—						
In municipality ...	...	241,303	...	...	73,637	...
In cantonments ...	...	25,517	...	...	45,763	...
Total ...	..	267,910	...	..	119,390	...
Cost of Works.	Rs.			Rs.		
Initial capital cost ...	...	...	15,15,730	...	...	7,51,710
Cost of subsequent works ...	...	...	97,162	...	...	...
Consumption of water.	Galls.	Galls.	Galls.	Galls.	Galls.	Galls.
For whole year, including cantonments	357,328,616	391,096,903	102,357,909	118,276,095	105,870,892	173,553,967
Daily average with cantonments ...	978,982	1,071,498	1,102,356	496,835	454,110	475,190
Maximum ditto in any one month.	1,312,380	1,362,917	1,431,216	461,125	601,872	1,183,338
Daily average for cantonments alone,	190,326	171,635	164,381	600	117,632	173,961
Do. maximum allowed in scheme for cantonments.	...	400,000	...	...	457,530	...
Total daily supply provided for in the scheme.	...	2,000,000	...	...	1,200,000	...
Average number of hours filtered water pumped per diem.	6.6	7.2	7.2	12.0	12.03	13.0
Per head of population per diem.						
As provided in the scheme ...	10 gallons all round.			10 gallons all round.		
As actually delivered on the census population.	Galls.	Galls.	Galls.	Galls.	Galls.	Galls.
Maximum ditto in any one month...	3.7	3.9	4.1	3.1	3.78	3.96
Annual Charges.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
(1) For delivering filtered water ...	50,366	50,562	51,334	21,233	21,378	25,636
(2) With interest and repayment of loan.	126,312	126,506	127,280	64,385	86,106	47,211
Income from sale of water, &c. ...	29,555	30,260	28,782	...	30,681	31,854
Net annual expenses, inclusive of interest and sinking fund.	96,757	96,248	98,498	64,385	55,425	15,357
Water-rate recovered during year ...	20,039	20,845	20,527	...	...	...
Actual cost of filtered water.	Annas.	Annas.	Annas.	Annas.	Annas.	Annas.
Per 1,000 gal- { For delivery of water	2.25	2.06	2.04	2.20	2.06	2.36
lons. { On gross charges ...	5.65	5.17	5.06	6.95	3.30	4.36
{ On net charges ...	4.33	3.93	3.91	6.95	5.37	1.41
For delivering water per head of population.	3.70	3.02	3.06	2.84	2.86	3.43
Number of house connections ...	216	362	374	42	64	82

TABLE No. III.

Comparative Statement of the working of the water-works in the North-Western Provinces and Oudh from 1893-1899 to 1900-1901—(concluded).

	Mussoorie.			Naini Tal.
	1898-1899.	1899-1900	1900-1901	1900-1901.
DATE OF OPENING.	16th April 1894.			Old Works October 1892. New works 31d June 1899.
Population.				
Provided for in scheme, including cantonments	...	6,000	..	15,000
According to census of 1891—				
In municipality	...	10,086	...	12,408
In cantonments	...	...	...	789
Total	...	10,086	...	13,197
Cost of Works.				
Initial capital cost	...	...	Rs. 41,505	Rs. 1,23,030
Cost of subsequent works	...	...	...	35,311
				2,29,325
Consumption of water.				
For whole year, including cantonments	Galls. 6,008,820	Galls. 4,298,750	Galls. 4,550,539	Galls. Gravity supply, 26,210,479 Pumped supply, 28,534,804
	Gravitation supply excluded.			Total ... 54,745,283
Daily average	26,009	18,854 (223 days)	22,733 (200 days)	150,069
Maximum daily average in any one month	30,309	29,000	32,872	163,538
Total daily supply provided for in the scheme	...	36,000	...	195,000
Average number of hours water pumped per diem.	10	8.95	11.15	16.8
Per head of population per diem.	Six gallons, excluding gravitation supply			13 gallons. 12½ gallons on average population of 12,241.
As provided in the scheme	2.6	1.8	2.2	...
As actually delivered on the census population.	4.3	3.1	3.8	...
As actually delivered on the project population	5.05	4.9	5.5	...
Annual Charges.				
(1) For delivering water	Rs. 7,052	Rs. 8,225	Rs. 8,405	Rs. 28,171
(2) With interest and repayment of loan	9,860	11,035	11,215	41,034
Income from sale of water, &c.	...	...	...	6,679
Net annual expenses, inclusive of interest and sinking fund.	9,860	11,035	11,215	34,355
Water-rate recovered during year	...	...	...	27,477
Actual cost of water.				
Per 1,000 gallons { For delivery of water	Annas. 18.80	Annas. 30.61	Annas. 29.55	Annas. *15.80
{ On gross charges	26.31	41.04	39.48	*23.01
{ On net charges	26.31	41.04	39.48	*19.26
Number of house connections	...	...	...	29

* Calculated on cost of pumped supply only.

TABLE No. IV.

Statement comparing the consumption and cost of coal at the various pumping stations during 1900-1901.

Municipality.	Agra.		Allahabad.		Benares.		Cawnpore.		Lucknow.		Mussoorie.	Name of.		
	River.	Filtered water.	River.	Khusru Bagh.	River.	Bhaddapur.	River.	Beas-Jhabar.	River.	Aish Bagh.		Low level.	Lake engines.	High level.
Million gallons pumped during year	527.7	437.5	632.2	545.2	930.6	911.0	818.8	656.0	489.1	402.8	4.55	0.18	6.20	16.15
Average lift ...	23.71	153.03	105.06	76.61	77.00	72.38	87.37	63.45	107.3	50.3	620	237	241	1152
Total coal consumed in boilers ...	1,254.65		1,157.1	(1) 477.10	847.0	771.4	874.82	640.53	893.1	547.1	182.5	(3) 93.56	(4) 61.67	(5) 853.23
			(2) 129.2	(2) 295.05							(See below.)			
Cost of coal per ton at pit head ...	3.00		1.2353	702.15										
			(1) 1.5	(1) 1.5	3.25	3.25	3.00	3.00	3.375	3.375		5.00	5.00	5.00
Ditto including carriage ...			(2) 3.625	(2) 3.625										
Total value of coal used during year ...	16.80		(1) 2.1	(1) 8.10	12.625	12.625	15.05	15.05	14.72	14.375		29.6	30.00	30.00
Coal used per million gallons pumped, Tons	21.067		(2) 12.72	(2) 12.85	10.683	9.740	13.156	9.613	11.74	7.883	45.4	(3) 2.616	(4) 1.810	(5) 10.168
Ditto raised 100 feet ...	1.236		89.63	59.03	0.910	0.847	1.413	.970	1.34	1.350	40.1	15.12	8.94	22.18
Cost of coal per million gallons pumped ...	1.800		1.934	1.673	1.182	1.177	1.617	1.463	1.533	1.680	6.47	5.23	4.14	1.96
Cost of coal per million gallons raised 100 feet ...	20.75		14.16	10.30	11.50	10.30	21.25	14.34	24.07	19.60	998.7	407.1	592.9	625.6
Kind of coal used ...	26.88		12.54	12.10	14.92	14.77	24.32	22.02	22.42	24.47	161.1	141.8	122.0	55.2
	Sejau steam		(1) Umar's sla k.	2.7—192 days	Steam coal from Bhagatpur Colliery.		One-fourth Rajnagar steam; balance Gau-rangdi steam coal.		Dhadka steam		Wood at Rs. 45 per 100 maunds.	Chanch and Giridih smithy.		
Supplied by ...	Bengal Coal Co.		...	...	Bengal-Nagpur Coal co.		Bengal Coal Co.		New Bloom Co.		Two tons of wood squared to one of coal.	Bengal Coal Co.		

NOTE.—(3) Includes 39 tons of wood, valued at ...
 (4) Ditto 48 ditto ...
 (5) Ditto 95.4 ditto ...
 Three tons of wood equivalent to one of coal.

The 24th May 1901.

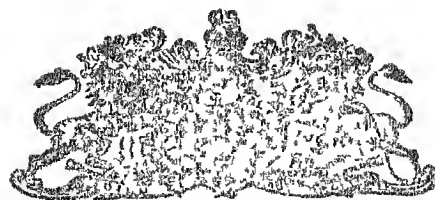
W. B. GORDON, SURGE. ENGR,
 Sanitary Engineer to Government, N. W. P. and Oudh.

FIFTH ANNUAL REPORT
OF THE
SANITARY ENGINEER

10

GOVERNMENT, N.-W. P. AND OUDH,

For the year ending 31st March 1900.



ALLAHABAD:

PRINTED AT THE NORTH-WESTERN PROVINCES AND OUDH GOVERNMENT PRESS.

1900.

The Fifth Annual Report of the Sanitary Engineer to Government, North-Western Provinces and Oudh, for the year ending 31st March 1900.

The post of the Sanitary Engineer to Government was held throughout the year by Mr. W. B. Gordon, Superintending Engineer, Public Works Department. The following places were visited by him during the year for the purpose of inspecting works or of preparing drainage schemes:—

No.	Towns visited.	Object of visit.	Remarks.
1	Agra ...	Inspection of water and drainage works ...	7 visits.
2	Aligarh ...	Do. the city drainage ..	3 do.
3	Allahabad ...	Do. water-works under maintenance ..	3 do.
4	Bahuch ...	Do. the drainage of the town ...	1 do.
5	Bareilly ...	Do. the city drainage ...	1 do.
6	Benares ...	Do. water and sewerage works ..	3 do.
7	Cawnpore ...	Do. ditto ditto ...	7 do.
8	Delhwa Dun ...	Do. water and drainage works ...	1 do.
9	Fatehpur ...	Do. the city drainage ..	1 do.
10	Fatehpur ...	Do. ditto ..	1 do.
11	Jhansi ...	Do. the locality for a water-supply ...	2 do.
12	Kanpur ...	Do. town drainage ..	1 do.
13	Kanpur ...	Do. the drainage of the town ...	1 do.
14	Kanpur ...	Do. water works ...	3 do.
15	Meerut ...	Do. ditto ..	3 do.
16	Mussoorie ...	Do. water works and sewage shoot ...	1 do.
17	Nainital ...	Do. water and drainage works ..	3 do.
18	Pilibhit ...	Do. the drainage of the town ..	1 do.
19	Saharanpur ...	Do. ditto ditto ...	3 do.
20	Saharanpur ...	Do. ditto ditto ...	1 do.

2. *Percentage of Municipal population supplied from water-works.*—Only nine out of the 104 Municipalities of these provinces have been provided with a water-supply delivered through pipes; but though the number of Municipalities is under 9 per cent. of the total, the populations of the nine Municipalities supplied from water-works aggregate 1,038,433, or nearly one-third of the total Municipal population of 3,147,922.

3. A brief account is given below of the working of the different water-works and of the progress made during the year on the schemes for water-supply and drainage.

4. *Agra.*—During my inspection of the works at the commencement of the year, I found the engines and pumps in a very bad state of repair; the electric light not in working order; the Green's economiser choked with scale and sediment, and the boilers pitted to a dangerous extent. Soon after Mr. Rogers, the present Municipal Engineer had taken over charge, the pumps and engines were overhauled; the necessary repairs are now nearly completed, and arrangements have been made for the supply and erection of four new Lancashire boilers at an estimated cost of Rs. 30,000. The average daily consumption of filtered water decreased from 1,519,673 gallons in 1898-99 to 1,459,785 gallons, or 8·61 gallons per head of population. There was again a decrease in the average daily consumption in Cantonments, which fell from 161,013 to 156,679 gallons. The construction of the fourth filter was put in hand during the year, and this much-required work is now nearly finished. The river training works have proved very successful, and the dry weather stream now flows close to the intake well.

Notwithstanding the large expenditure which had to be incurred in special repairs to the engines and pumps, and the low pressure at which the boilers had to be worked, the maintenance charges are slightly below those of the previous year; they amount to Rs. 54,823. The cost of delivering 1,000 gallons of filtered water amounts to 1·65 annas, being a slight increase over the figure for the previous year.

Surveys were made for a project for a sewer to intercept, and carry to a point on the river below the Dhobi's Ghâts, the sullage water which now finds its way into the river at a number of points above the railway bridge. Subsequently, at the request of the Board and under instructions from Government, the preparation of

the plans and estimates was postponed pending trial of temporary and less costly expedients for disposing of the sullage.

5. *Allahabad*.—Owing chiefly to the early cessation of the rains, the average daily consumption rose from 1,110,229 to 1,490,893 gallons, or 8.5 gallons per head of the census population.

The maintenance charges amount to Rs. 51,851, or Rs. 5,500 in excess of those for the previous year. The excess is chiefly under "purchase of sand for filters" and "pipes and fittings". The cost of delivering 1,000 gallons of filtering water works out to 1.61 annas. On removing the filtering media from filter No. 1, the floor of the filter was found to be badly cracked. Previous observations had shown that the loss from leakage amounted to as much as 90,000 gallons per day. The crack was carefully repaired before the filtering media were renewed. The good effects of the repairs also carried out on the settling tank are shown by the fact that although the engines at the river station worked for 260 hours less than in the previous year, the volume pumped according to measurements made in the settling tanks is 3 millions more than in the previous year.

The receipts amount to Rs. 1,03,781, being an increase of Rs. 5,600 over the income of the previous year. There is a satisfactory increase of over Rs. 3,000 in the receipts from the sales of water.

The necessity of providing spare meters has been brought to the notice of the Board, and also the advisability of substituting surface condensers for the jet condensers at Karola Bagh. In drawing supply through the new suction of A engine, it was found that there was very considerable shock and vibration. This was due to the air chamber having been placed too far from the pump. It will now be removed and placed in the pump well as close to the pump as possible.

6. *Benares*.—The rapidity with which the consumption of filtered water in this Municipality is increasing, is very remarkable. During the past three years the consumption has been as follows :—

					Gallons.
1897-98	...	...	...	...	695,104,100
1898-99	...	...	...	...	852,670,719
1899-1900	...	...	...	...	960,202,743

Thus within three years, the consumption has risen by nearly 40 per cent., while the number of house connections has only increased from 3,632 to 4,071, or by 12 per cent. The consumption per head of population—12.20 gallons—is now considerably in excess of that of any other large Municipality in these provinces. The increase in recent years is, no doubt, chiefly due to increased waste of water. Many of the stand-posts and private taps are in need of repairs, but in addition to the waste due to leakage, there is enormous loss from taps being allowed to discharge into the house drains for flushing purposes. During one of my visits of inspection, I found that the Pipe Line Inspector employed by the Board was quite unqualified for the post, and I recommended his removal. The Board have now secured the services of a qualified Inspector, and it is hoped that his exertions, under the direction of the Resident Engineer, will lead to a considerable reduction in the waste of water.

The maintenance charges amount to Rs. 68,626, being Rs. 2,727 less than in the previous year. The cost of delivering filtered water works out to the exceptionally low figure of 1.01 anna per 1,000 gallons.

On the new sewerage works, an expenditure of Rs. 72,740 was incurred during the year. The Bengali Tola Branch (lower portion) and the Malanpara Branch sewers were completed. Good progress was made on the Dasasamedh pumping station, and on the lower portion of the Benimadho Branch sewer. The construction of branch sewers in the "sewered area" is necessarily a slow process, and as the Resident Engineer was working with an untrained staff, the supervision of these works occupied most of his time, and very little progress was made on works in the "unsewered area". It is hoped that during this year, considerable progress will be made in the construction of pail depots and latrines in this area.

With a view to reducing the amount of the loan for sewerage works from 17 lakhs to 10 lakhs, a modified project and revised estimate was prepared, and received the sanction of Government.

7. *Cawnpore*.—Compared with the previous year, the average daily consumption of filtered water rose from 8·74 to 9·17 gallons per head of population. Seventy-nine million gallons of water were supplied to the Mills and Tannery Company at a rate of 2 annas per 1,000 gallons, bringing in a revenue of Rs. 9,871. To the Cantonment authorities 1,519,625 gallons were supplied for watering roads at 5 annas per 1,000 gallons.

The ordinary maintenance charges for the year amount to Rs. 70,206, and the cost of delivering water per 1,000 gallons, amounts to 2·05 annas per head of population, or practically the same as in the previous year. Excavating and maintaining the channel to the intake well cost Rs. 7,429. In addition to the ordinary maintenance charges, an expenditure of Rs. 20,894 was incurred on the following "extraordinary" works:—Extensions of mains (Rs. 5,619); flushing extensions (Rs. 300); river training works Rs. (14,915). The training works carried out during the past two years are now beginning to have effect over the course of the river. The old channel past the intake and along the river front of the town has widened considerably and deepened. At one time the river showed a marked tendency to cut across the high ground on the left bank, and to take a course still further away from the intake than the present channel. The training works alone prevented it from taking this course. The tree-spurs were well made, and though designed as merely temporary works, they withstood the floods admirably.

The total receipts for the year amount to Rs. 19,194. The receipts from sale of water amount to Rs. 17,961, against Rs. 15,557 in 1898-99 and Rs. 8,018 in 1897-98. The steady increase in the revenue derived from sales of water is satisfactory.

The question of disposing of the sewage of the town in a less costly way than that proposed by Mr. Baldwin Latham in 1891, was very fully considered during the year. In a joint note, dated 21st August 1899, the Sanitary Commissioner and the Sanitary Engineer recommended that the sewage should be treated by the biological process and discharged directly into the river instead of being carried to a point below Cantonments. They recommended that preliminary experiments be made to test the working of a septic tank and biological filter in the climate of Cawnpore. Opportunity was taken of Mr. Santo Cinqu's visit to India to consult him on the subject. He advised the Board to adopt a scheme on somewhat similar lines to that proposed by Mr. Baldwin Latham, but instead of disposing of the sewage on an expensive sewage farm, he recommended that it be treated by filtration through a macerating tank. Finally, at the end of March, the Sanitary Commissioner and the Sanitary Engineer, in consultation with the Civil Surgeon and Resident Engineer, considered carefully the various proposals which had been made for disposing of the sewage and the general measures required for the sanitary improvement of the Municipality. Their joint note on the subject is now under the consideration of the Municipal Board.

8. *Lucknow*.—The average daily consumption in the City and Cantonments was 1,071,498, or 3·9 gallons per head of the census population, and 5·4 gallons per head of the population within reach of supply. In addition to the water required for the filtered supply to the City and Cantonments, 64½ million gallons were supplied to the Victoria Parks during the year. The Trustees of the Hazratganj Endowment Fund have now, with the assistance of the District Engineer, made arrangements for erecting separate pumping machinery for the supply of the Parks.

The maintenance charges for the year amount to Rs. 50,562, equivalent to 2·06 annas per 1,000 gallons of filtered supply. The total receipts amount to Rs. 51,112, against Rs. 50,000 in the previous year.

9. *Meerut*.—The average daily consumption was 451,440 gallons, or 3·78 gallons per head of population. Cantonments took 42,809,180 gallons, or about one-fourth of the total supply. Excluding Cantonments the average daily consumption

was 336,903 gallons, against 406,235 gallons in the previous year and 461,899 gallons in 1897-98. The Superintendent has been asked for an explanation of this gradual decrease in the consumption outside of cantonments.

The maintenance charges amount to Rs. 21,378, or practically the same as in the previous year.

10. *Mussoorie*.—The returns in connection with the working of the water-works during 1899-1900 have not yet been received.

At the request of both the parties concerned, the Sanitary Engineer acted as arbitrator in the matters in dispute between the Board and the contractors in connection with construction of the Bhilaru sewage shoot, and the accounts for the work were finally closed during the year. The shoot is acting very satisfactorily, and it has enabled the number of bullocks employed by the Municipality for the removal of nightsoil to be reduced from 50 to an average of 15 throughout the year.

11. *Naini Tal*.—The works for extending and remodelling the water-supply system were practically completed during the year, and the whole station is now covered with a net-work of pipes; and pure drinking water is delivered within a short distance of every house. The total expenditure on the works to the end of the year amounted to Rs. 2,19,219, against a sanctioned estimate of Rs. 2,55,000. After all payments have been made, there will be a saving of over Rs. 25,000. This saving the Municipal Board have decided to utilize in the purchase of meters for the measurement of water supplied to houses with house connections. During five months of the year, the contractors were responsible for the working and maintenance of the engine.

The maintenance charges for the year amount to Rs. 20,164, and the gross charges with interest and sinking fund to Rs. 46,474. The receipts amount to Rs. 19,835.

12. *Coal Consumption at pumping stations*.—A statement (Table IV) comparing the consumption and cost of coal at the various pumping stations is now, for the first time, appended to this report. The consumption of coal at Agra is excessive owing to the state of the boilers, these have to be worked at such a low pressure that the steam cannot be used expansively. Benares shows the best results, and generally at stations with the older patterns of engines, the consumption is less than at those provided with direct acting steam pumps of the Worthington type. At Lucknow the consumption of coal at the river station appears to be higher than it ought to be.

13. *Rajpur and Dehra Dún*.—During my inspection of the Dehra-Rajpur water-works in August 1899, I found that though the full supply of water was being delivered into No. 1 reservoir, only 10 gallons a minute were passing into tank No. 7, instead of 30 gallons, as designed, and there was considerable waste of water at No. 1 reservoir, while the jail was receiving a very insufficient supply. I found that the small flow towards No. 7 was due to air accumulating in the pipes. This was prevented by the insertion of an air outlet drum at a suitable point in the pipe line. Reservoir No. 7 and the jail reservoir now receive an ample supply and there is a surplus of water on this line, which should be utilized for the supply of the village of Karanpura.

Surveys were put in hand with a view to the preparation of a project for improving the drainage of the town.

14. *Aligarh*.—The surveys of the town were completed during the year, and estimates for providing main outfall drains for the sullage water of the town are under preparation.

15. *Māthras*.—An estimate for improving the main outfall drain of the town was prepared during the year, and the work of construction is now in hand.

16. *Sahāranpur*.—An estimate, which was prepared for the improvement of the Craigie Nala, is being submitted to the Sanitary Board for approval.

17. *Pilibhīt and Sitapur*.—The Municipal Boards were advised as regards the further extension of the drainage system of these towns, and were furnished with estimates of the probable cost.

18 *Delay in submission of returns.*—Most of the returns required for the preparation of this report, which is due on the 1st May, were not received until the middle of that month. The reports from Mussoorie and Naini Tal have not yet been received. Blank forms showing the information required, from the various Municipal offices, for the preparation of this report, are now being printed. In future it will only be necessary to fill in these forms and return them to this office. This will, no doubt, expedite the submission of the returns; but I am doubtful if it will be possible to prepare a complete report by the 1st of May, though it may be possible to do so by the 15th of the month.

NAINI TAL. }
The 25th May 1902. }

W. B. GORDON, SUPDG. ENGR.,
Sanitary Engineer to Govt, N. W. P. and Oudh.

TABLE No. 1.

Statement showing progress on Major Sanitary Works during 1899-1900.

Name of Municipality.	Serial number.	Nature of work	Cost.		
			Estimate	Spent during 1899-1900.	Total spent up to 31st March 1900
			Rs.	Rs.	Rs.
Agra ...	1	Construction of fourth filter ..	32,000	11,223	11,223
Do ...	2	Providing spare machinery and fittings ..	2,782	2,782	2,782
Allahabad ...	3	Karela Bāgh extension	23,951	1,605	21,516
Aligarh ...	4	Drainage scheme. Preliminary expenses ...	...	168	2,01
Cawnpore ..	5	Sewerage work. Ditto ..	2,100	2,073	2,07
Ditto ...	6	Extension of mains	5,970	5,619	5,619
Ditto ...	7	River Training Works ..	15,154	11,941	11,911
Ditto ..	8	Sadar Bāzār Drainage Work	4,600	4,487	4,4
Ditto ...	9	Flushing drains	3,337	3,100	3,100
Hāthras ...	10	Hāthras drainage	9,144	2,583	2,583
Benares ...	11	Raised tower	79,236	3,000	70,021
Ditto ...	12	Sewerage scheme	13,00,000	72,721	8,00,368
Jhānsi ...	13	Experiment at Punch Kua ... ..	...	125	1,512
Ditto ...	14	Survey expenses ... ..	...	101	1,904
Pilibhit ...	15	Drainage work ... ..	...	665	665
Naini Tal ...	16	Remodelling water-supply	2,55,000	62,239	2,19,219
Mussoorie ...	17	Bhilaru sewage shoot	69,000	9,395	68,204

NAINI TAL :
The 25th May 1900.

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W. B. GORDON, SURDG. ENGR.,
Sanitary Engineer to Govt., N. W. P. and Oudh.

TABLE No. II.

Accounts of fees for Sanitary Engineer's services demanded and recovered during 1899-1900.

Name of Municipality.	Fees demanded under rules in the Municipal Manual					Due for arrears not paid in 1898-99.	Deduct excess recoveries made.	Net total fees due.	Fees recovered during 1899-1900.	Outstanding balance of fees not paid and to be recovered in 1900-1901.	Doubtful fees not accepted.
	Under Rule 26(7).	Under Rule 26(3) at 1 per cent.	Under Rule 26(5) at 3 and 2 per cent.	Total.	Rs. a. p.						
1 Aligarh	...	38 0 0	...	38 0 0	...	...	...	38 0 0	38 0 0	...	...
2 Bahraich	100 0 0	...	...	100 0 0	...	...	...	100 0 0	100 0 0	...	...
3 Benares	...	...	...	...	...	...	...	...	...	...	...
4 Cawnpore	...	85 0 0	...	85 0 0	...	...	...	85 0 0	85 0 0	...	...
5 Hathras	...	91 7 0	...	91 7 0	...	...	...	91 7 0	91 7 0	...	...
6 Lucknow	...	389 0 0	...	389 0 0	...	...	...	389 0 0	389 0 0	...	...
7 Mussorie	...	15 0 0	960 7 5	975 7 5	...	...	...	975 7 5	975 7 5	...	...
8 Naini Tal	...	...	...	...	1,077 10 0	...	...	...	1,077 10 0	...	...
9 Pilibhit	...	64 8 0	...	64 8 0	...	...	...	64 8 0	64 8 0	...	...
10 Sitapur	100 0 0	...	...	100 0 0	...	...	...	100 0 0	100 0 0	...	...
GRAND TOTAL	200 0 0	676 15 0	960 7 5	1,837 5 5	1,077 10 0	...	...	...	2,915 0 5	...	...

* NOTE.—Excess fees recovered in previous years

Adjustment made on account of Sanitary Engineer's fees due in 1897-98=8,414 0 2

Ditto

1898-99=1,381 6 3

Balance to be recovered

Adjustment made for 1899-1900

Balance of fees to be recovered in future years

NAETI TAL:

The 25th May 1900.

W. B. GORDON, Secy. to Bd. Engrs.

Sanitary Engineer to Government, N.W.P. and Oudh

TABLE No. III.

Comparative Statement of the working of the water-works in the North-Western Provinces and Outh, 1897-98 to 1899-1900.

	Agra.			Allahabad		
	1897-98	1898-99.	1899-1900.	1897-98.	1898-99	1899-1900.
DATE OF OPENING	3rd November 1890.			26th March 1891.		
Population.						
Provided for in scheme including cantonment.	...	1,00,000	...	...	1,31,000	...
According to census of 1891—						
In Municipality	...	1,16,208	...	...	1,62,895	...
in Cantonment	...	23,301	...	...	12,351	...
Total	...	1,39,509	...	...	1,75,246	...
Cost of Works.			Rs.			R.
Initial capital cost	...		11,70,761	...	...	16,21,063
Cost of subsequent works	...		1,57,701	...	...	75,301
Consumption of water.	Gallons.	Gallons.	Gallons.	Gallons.	Gallons.	Gallons.
For whole year including Cantonments	488,474,553	554,682,661	532,821,434	520,185,016	514,733,706	514,143,100
Daily average with ditto	1,338,177	1,519,678	1,459,785	1,425,164	1,410,229	1,400,603
Ditto without ditto	1,152,459	1,355,775	1,308,106	1,292,326	1,298,323	1,361,448
Ditto for Cantonment alone	185,718	164,013	156,679	132,838	111,906	120,357
Daily maximum allowed in scheme for Cantonments.	...	250,000	...	About 200,000		
Total maximum in any one day	2,325,991	2,461,919	1,869,992	2,373,822	2,180,496	2,357,932
Total daily supply provided for in the scheme.	1,500,000 2,000,000	Gallons for engines. Ditto pipes.		5,000,000 gallons. Ultimately to 2,850,000 gallons		
Per head of population per diem						
As provided in the scheme	15 gallons for engine-power. 20 ditto pipes. Gallons.			15 gallons all round. Gallons.		
As actually delivered on the census population...	7-39	8-96	8-67	8-13	8-04	8-51
Ditto ditto project population...	13-38	15-19	14-59	10-63	10-52	11-46
Maximum on the project population	23-25	24-61	18-69	17-71	16-25	17-59
Ditto census population	13-72	14-61	11-03	13-54	12-41	13-46
Number of hours filtered water pumped per diem average.	8-53	8-93	8-70	9-60	9-82	10-72
Annual charges.			Rs.			Rs.
(1) For delivering filtered water	55,210	55,303	54,823	53,067	49,354	54,854
(2) With interest and repayment of loan	148,400	109,115	151,807	148,450	147,472	158,132
Income from water-works, gross	43,600	42,966	40,848	92,196	98,181	103,781
Net annual expenses inclusive of interest and sinking fund.	104,990	66,119	110,959	56,263	49,291	54,651
Actual cost of filtered water.			Annas.			Annas.
Per 1,000 gallons ... { For delivery of water	1-80	1-59	1-65	1-63	1-58	1-67
... { On gross charges	4-86	3-14	4-56	4-59	4-38	4-66
... { On net charges	3-43	1-01	3-33	1-73	1-53	1-60
For delivering water per head of population	5-21	6-24	5-17	4-84	4-50	5-00
Number of house connections	627	654	674	1248	1327	1447

TABLE No. III.

Comparative Statement of the working of the water-works in the North-Western Provinces and Oudh, 1897-98 to 1899-1900—(continued).

			Benares.			Cawnpore.		
			1897-98.	1898-99.	1899-1900.	1897-98.	1898-99.	1899-1900.
DAILY SUPPLYING								
Population.			18th November 1892.			17th March, 1894.		
As provided for in scheme including Cantonments ...			...	2,00,000	...	...	2,10,000	...
According to census of 1891—								
in Municipality	...	...	...	2,11,566	...	...	1,63,170	...
in Cantonments	...	...	...	6,290	...	...	21,933	...
Total	...	...	...	2,17,856	...	...	1,85,103	...
Cost of Works.								
Initial capital cost	...	...	...	Rs. 25,61,681	...	...	...	14,11,353
Cost of subsequent works	...	...	...	77,797	...	...	...	56,418
Consumption of water.			Gallons.	Gallons.	Gallons.	Gallons.	Gallons.	Gallons.
For whole year including cantonments	...	...	695,401,100	852,670,719	970,202,743	383,774,398	522,615,903	546,612,075
Daily average with	ditto	...	(Supply not yet extended to Cantonments)			(Supply not yet extended to Cantonments)		
Ditto without	ditto	...	1,905,206	2,336,084	2,638,039	1,325,109	1,431,901	1,457,517
Ditto for Cantonment alone	...	...	...	...	...	...	...	...
Daily maximum allowed in scheme for Cantonment.	...	...	...	...	...	...	...	...
Total maximum in any one day	...	...	2,822,976	2,969,668	3,357,516	2,039,895	1,896,885	1,974,700
Total daily supply provided for in the scheme.			4,000,000 gallons.			4,000,000 gallons.		
Per head of population per diem.								
As provided in the scheme	...		20 gallons all round.			20 gallons all round.		
			Gallons.			Gallons.		
As actually delivered on the census population	...		9-00	11-04	12-20	8-09	8-71	9-17
Ditto ditto project population	...		9-52	11-68	13-29	6-22	7-16	7-48
Maximum on the project population	...		14-11	14-84	16-78	10-30	9-50	9-82
Ditto census population	...		13-34	14-03	15-41	12-60	11-60	12-01
Number of hours filtered water pumped per diem average.	...		8-00	8-00	8-20	10-38	10-50	10-50
Annual charges.			Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
(1) For delivering filtered water	...		68,677	63,353	60,626	68,129	68,902	70,206
(2) With interest and repayment of loan	...		1,63,521	1,48,197	1,45,170	1,22,119	1,22,892	1,24,196
Income from water-works, gross	...		65,136	1,13,446	90,166	10,102	15,897	13,194
Net annual expenses inclusive of interest and sinking fund.	...		58,385	34,753	55,304	1,12,017	1,06,995	1,05,002
Actual cost of filtered water.			Annas.	Annas.	Annas.	Annas.	Annas.	Annas.
Per 1,000 gallons ...			1-24	1-19	1-01	2-25	2-03	2-06
	For delivery of water	...	3-77	2-79	2-42	4-04	3-78	3-63
	On gross charges	...	2-27	0-65	0-02	3-75	3-27	3-07
	On net charges	...	4-43	3-34	4-58	6-65	6-75	6-48
For delivering water per head of population	...							
Number of house connections	...		3,632	3,854	4,071	107	200	273

TABLE No. III.

Comparative Statement of the working of the water-works in the North-Western Provinces and Oudh, 1897-98 to 1899-1900.—(continued).

	Lucknow.			Meerut.		
	1897-98.	1898-99.	1899-1900.	1897-98.	1898-99.	1899-1900.
DAILY OPENING.	5th July 1894.			6th May 1896.		
<i>Population.</i>						
Provided for in scheme including Cantonments ...	...	2,00,000	...	...	1,20,000	...
According to census of 1891—						
In Municipality ...	...	2,14,393	...	...	73,637	...
In Cantonments ...	...	23,517	...	...	45,753	...
Total ...	...	2,67,910	...	...	1,19,390	...
<i>Cost of Works.</i>			Rs.			Rs.
Initial capital cost ...	...	...	1,515,736	...	...	751,710
Cost of subsequent works ...	...	...	97,162	...	...	...
<i>Consumption of water.</i>	Gallons.	Gallons.	Gallons.	Gallons.	Gallons.	Gallons.
For whole year including Cantonments ...	346,581,925	357,328,616	391,096,903	168,593,461	148,276,095	165,870,802
Daily average with ditto ...	949,539	978,982	1,071,198	...	...	454,110
Ditto without ditto ...	777,089	788,656	900,163	461,899	406,235	536,908
Ditto for Cantonment alone ...	172,530	190,326	171,035	...	600	117,532
Daily maximum allowed in scheme for Cantonments ...	...	400,000	...	423,116	45,753	...
Total maximum in any one day ...	1,483,016	1,650,285	1,662,900	...	618,624	604,872
Total daily supply provided for in the scheme.	2,000,000 gallons.			1,200,000 gallons.		
<i>Per head of population per diem.</i>						
As provided in the scheme ...	10 Gallons all round. Gallons.			10 Gallons all round. Gallons.		
As actually delivered on the census population...	3.12	3.7	3.9	3.9	3.4	3.78
Ditto ditto project population ...	5.24	4.9	5.3	3.8	3.4	3.75
Maximum on the project population ...	7.14	8.3	8.3	4.0	5.2	5.04
Ditto census population ...	5.16	6.2	6.2	4.2	5.2	5.04
Number of hours filtered water pumped per diem, average.	6.60	6.6	7.2	12.0	12.0	12.03
<i>Annual charges.</i>	...	Rs.	...	Rs.	Rs.	Rs.
(1) For delivering filtered water ...	54,321	50,366	50,562	21,531	21,233	21,378
(2) With interest and repayment of loan ...	130,267	126,312	126,508	61,683	64,385	86,106
Income from water-works, gross ...	52,735	49,594	51,105	...	...	30,681
Net annual expenses inclusive of interest and sinking fund.	77,522	76,718	75,403	...	64,385	55,425
<i>Actual cost of filtered water.</i>	Annas.	Annas.	Annas.	Annas.	Annas.	Annas.
For 1,000 gallons ...	2.50	2.25	2.06	2.04	2.20	2.06
{ For delivery of water ...	5.37	7.83	5.17	...	6.05	5.30
{ On gross charges ...	1.49	5.66	3.09	...	2.20	5.37
For delivering water per head of population ...	3.00	3.70	3.02	2.86	5.19	2.86
Number of house connections ...	154	216	303	24	42	64

	Mussoorie.			Naini Tal.		
	1897-98.	1898-99.	1899-1900	1897-98.	1898-99.	1899-1900.
DATE OF OPENING.	16th April, 1891.			October 1892.		
Population.						
Provided for in scheme including Cantonment ...	...	6,000	...	...	15,000	...
According to census of 1891—	(4,000 supplied by gravitation system.)			(4,800 supplied by gravitation system.)		
In Municipality ...	...	10,086	...	...	12,408	...
In Cantonments ...	...	...	...	...	789	...
Total	...	10,086	...	...	13,197	...
Cost of works.	Rs.			Rs.		
Initial capital cost ...	...	...	...	...	...	1,28,030
Cost of subsequent works ...	...	...	...	...	...	35,311
						2,19,219
Consumption of water.	Gallons.	Gallons.	Gallons.	Gallons.	Gallons.	Gallons.
For whole year, including Cantonments ...	...	6,009,820	...	...	...	15,429,807
Daily average with Cantonments ...	343,840	...	...	...	...	...
Ditto without ditto ...	...	26,009	...	...	...	...
Ditto for Cantonment alone ...	...	...	...	...	...	...
Daily maximum allowed in scheme for Cantonments.	...	...	...	...	...	2,400
Total maximum in any one day ...	...	47,708	...	...	...	...
Total daily supply provided for in the scheme ...	36,000 gallons.			60,000 gallons.		
Per head of population per diem.						
As provided in the scheme ...	6 Gallons.			...	...	...
As actually delivered on the census population ...	(Gravitation supply not gauged.)			...	...	...
Ditto ditto project population ...	1.8	3.4	...	...	...	...
Maximum on the project population ...	3.4	...	...	...	...	...
Ditto ditto census population ...	...	...	...	...	...	...
Number of hours filtered water pumped per diem, average.	12.4	10	...	...	...	...
Annual charges.	Rs.	Rs.				
(1) For delivering filtered water ...	5,219	7,052	...	8,484	6,825	20,164
(2) With interest and repayment of loan ...	...	9,860	...	13,372	16,602	46,474
Income from water-works, gross ...	8,027	...	...	...	503	19,935
Net annual expenses inclusive of interest and sinking fund.	...	9,860	...	18,372	16,099	26,630
Actual cost of filtered water.	Annas.			Annas.		
For delivery of water ...	...	1.17	...	...	...	20.89
On gross charges ...	...	1.64	...	...	...	43.18
On net charges ...	...	1.64	...	...	...	27.63
For delivering water per head of population ...	...	...	...	...	...	24.43
Number of house connections	...	...	...	3	3	14

TABLE NO. IV.

Statement comparing the consumption and cost of coal at the various pumping stations during 1899-1900.

Municipality.	Agra.		Allahabad.		Benares.		Cawnpore.		Lucknow.	Mussorie.	Naini Tal.
	River.	Filtred water.	River.	Khusru Bagh.	River.	Bhakupura.	River.	Benajhabar.	River.	Aish Bagh.	
Million gallons pumped during year	503.0	532.98	627.11	544.1	970.2	970.2	543.5	546.4	487.0	801.1	
Average lift	30.17	12.19	98.93 (1) 410.2 (2) 595.9	75.37 128.0 417.4	80.12	77.56	87.13	74.05	107.4	80.8	
Total coal consumed in boilers	1,416.75		1,006.1	575.4	939.25	878.83	701.75	562.05	811.60	453.20	
Cost of coal per ton at pit-head	8.00		(1) 1.875 (2) 3.403	1.875 3.468	3.25	3.25	3.00	3.00	4.00	4.00	
Ditto including carriage	16.66		(1) 6.532 (2) 12.437	6.344 12.312	12.625	12.625	15.05	15.05	15.43	15.17	
Total value of coal used during year	23,663		10,069	6,194	11,730	11,065	10,501	8,407	12,522	6,876	
Coal used per million gallons pumped	1.201		1.601	1.057	0.949	0.907	1.270	1.059	1.637	1.158	
Ditto ditto raised 100 feet	1.703		1.631	1.403	1.184	1.169	1.467	1.373	1.552	1.442	
Cost of coal per million gallons pumped	21.53		16.05	11.89	11.08	11.45	19.25	15.49	25.70	17.68	
Ditto ditto raised 100 feet	28.37		16.25 (1) Umaria slack. 89 ... 50 days. (2) Girih smithy. 2.53 ... 315 days.	15.12	14.95	14.76	22.69	20.07	23.94	21.89	
Kind of coal used	Sajna steam.				P steam.		Bareeganj steam.		Dhadda steam.		
Supplied by	Bengal Coal Co.				Bengal Nagpur Co.		Bengal Coal Co.		New Beerbhoom Co.		

W. B. GORDON, Secy. Engr.,
Sanitary Engineer to Government, N. W. P. and Oudh.

